PATENT ABSTRACTS OF JAPAN

(11)Publication number : **11-089798**
(43)Date of publication of application : **06.04.1999**

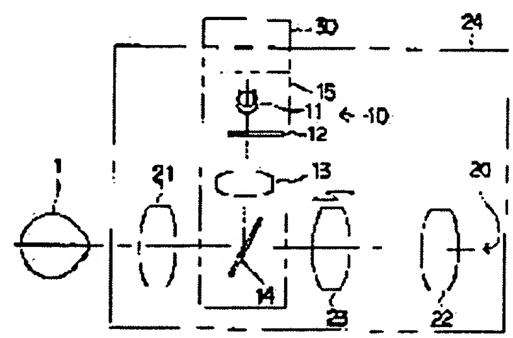
(51)Int.CI. A61B 3/14

(21)Application number : **09-272050**
(22)Date of filing : **18.09.1997**

(71)Applicant : **NIKON CORP**
(72)Inventor : **TAKAHASHI YOSHIHIRO**
TOMIOKA KEN
KANEKO MASANOBU
KATO HIROMASA

(54) OPHTHALMOLOGICAL OBSERVATION DEVICE

(57)Abstract:
PROBLEM TO BE SOLVED: To provide an ophthalmological observation device which can change an angle of an introduced light and reduce a flare in an cross-focusing and inclined lighting ophthalmological observation device.
SOLUTION: This ophthalmological observation device consists of an observation part, observation optical system 20, light source 11 which emits lighting and lighting optical system 10. The observation part observes subjects eye 1 through object lens 21. The observation optical system 20 has focusing lens 23 which focuses an image of the subject's eye 1 on the observed part. The lighting optical system 10 has reflecting mirror 14 which reflects the lighting from the light source 11 and introduces the light into the testee's eye 1 with the different angle from the light axis of the observation optical system 20 and through the object lens 21. This device is also equipped with angle changing part 30 which changes the position of the reflecting mirror 14 by moving the reflecting mirror 14 so that angle of introduced illumination light θ toward the subject's eye 1 can be altered.



LEGAL STATUS
[Date of request for examination]
[Date of sending the examiner's decision of rejection]
[Kind of final disposal of application other than the examiner's decision of rejection or application converted registration]
[Date of final disposal for application]
[Patent number]

[Date of registration]
[Number of appeal against examiner's decision of rejection]
[Date of requesting appeal against examiner's decision of rejection]
[Date of extinction of right]

CLAIMS

[Claim(s)]
[Claim 1] The observation optical system which has the observation section which observes optometry-ed through an objective lens, and the focussing lens which makes the image examined [said] the eyes focus to this observation section, It is the include angle from which the optical axis of said observation optical system differs the illumination light from the source of the illumination light which emits the illumination light, and this source of the illumination light. And ophthalmology observation equipment characterized by having an include-angle modification means to move said light guide means and to change the light guide include angle of the illumination light to said optometry-ed in ophthalmology observation equipment equipped with the illumination-light study system which has the light guide means led to said optometry-ed through said objective lens.
[Claim 2] Said include-angle modification means is ophthalmology observation equipment according to claim 1 characterized by the ability to change into the include angle for which it was suitable in order to illuminate eyegrounds examined [of a mydriasis condition] the eyes of said light guide include angle, or the include angle for which it was suitable in order to illuminate eyegrounds examined [of a non-mydriasis condition] the eyes freely.
[Claim 3] eyegrounds examined [said] the eyes in said illumination-light study system, and abbreviation -- the ophthalmology observation equipment according to claim 1 or 2 characterized by having the radiation field diaphragm which has the first of a configuration and the second opening from which it is and differs for narrowing down the lighting range of said illumination light to a location [****] mutually.
[Claim 4] In case it is changed into the include angle for which it was suitable in order that said light guide include angle might illuminate eyegrounds examined [of a mydriasis condition] the eyes with said include-angle modification means, the first opening of said radiation field diaphragm is minded. The lighting range of the illumination light A rat tail, And so that the lighting range of the illumination light may be narrowed down through the second opening of said radiation field diaphragm, in case it is changed into the include angle for which it was suitable in order that said light guide include angle might illuminate eyegrounds examined [of a non-mydriasis condition] the eyes with said include-angle modification means Ophthalmology observation equipment according to claim 3 characterized by having a interlocking means to interlock said include-angle modification means and said radiation field diaphragm.
[Claim 5] Ophthalmology observation equipment according to claim 1 to 4 characterized by having a calculation means to have a pupil diameter measurement means for measuring the pupil diameter examined the eyes, and to compute said light guide include angle based on the measurement result of this pupil diameter measurement means, and the control means which controls said include-angle modification means based on the light guide include angle computed with said calculation means.
[Claim 6] The observation optical system which has the observation section which observes optometry-ed through an objective lens, and the focussing lens which makes the image examined [said] the eyes focus to this observation section, It is the include angle from which the optical axis of said observation

optical system differs the illumination light from the source of the illumination light which emits the illumination light, and this source of the illumination light. And it sets to ophthalmology observation equipment equipped with the illumination-light study system which has the light guide means led to said optometry-ed through said objective lens. The perpendicular include angle of the optical axis of said illumination light by said light guide means and the optical axis of said observation optical system to make is set up so that it may be suitable in order to illuminate eyegrounds examined [of a non-mydriasis condition / said] the eyes. In the 1st flat surface which contains said perpendicular include angle so that it may be suitable in order to illuminate eyegrounds examined [of a mydriasis condition / said] the eyes, and the 2nd flat surface which carries out an abbreviation rectangular cross Ophthalmology observation equipment characterized by establishing an include-angle modification means by which the level include angle of the optical axis of said illumination light by said light guide means and the optical axis of said observation optical system to make can be set up.

[Translation done.]

* NOTICES *

DETAILED DESCRIPTION

[Detailed Description of the Invention]
[0001]
[Field of the Invention] This invention relates to the ophthalmology observation equipment which has the description in the structure for performing lighting especially to optometry-ed about the ophthalmology observation equipment for observing optometry-ed.
[0002]
[Description of the Prior Art] There are various things, such as an inverted-image mirror and a direct ophthalmoscope, in the ophthalmology observation equipment for observing eyegrounds examined the eyes. What a focus method is internal focusing which is moved in the direction of an optical axis, and performs the focussing lens inside equipment among such ophthalmology observation equipment, and is the oblique illumination type to which the lighting method to optometry-ed carries out the light guide of the illumination light to optometry-ed at the include angle from which the optical axis of observation optical system differs is offered, and, generally this is called the large ophthalmoscope. As shown in drawing 18 , this large ophthalmoscope is equipped with the illumination-light study system which has the observation optical system which has an objective lens 100, the ocular 101 for observing the optometry 1-ed through this objective lens 100 and focussing lens 102, and the focal mirror 106, and the reflective mirror 104 which turns to the optometry 1-ed the illumination light of the source 103 of the illumination light which emits the illumination light, and the source 103 of the illumination light, and is reflected, and is constituted. The reflective mirror 104 of an illumination-light study system carries out the light guide of the illumination light from the source 103 of the illumination light to the optometry 1-ed at an include angle which is different in the optical axis 105 of observation optical system.
[0003]
[Problem(s) to be Solved by the Invention] Generally, if the include angle (it only considers as a "light guide include angle" hereafter) of the optical axis 105 of observation optical system and the optical axis 107 of an illumination-light study system to make becomes small, the duplication range of an illumination-light bundle and the observation flux of light will become large, and the flare which this duplication range and the lens front face examined [1] the eyes lap, and is produced will also become large. Thus, if the flare becomes large, since observation light will be made muddy and observation will become difficult with this flare, it is desirable to take a large light guide include angle as much as possible, and not to produce the flare.
[0004] When observing eyegrounds examined [1] the eyes here, the two observation approaches of the mydriasis observation which observes in the condition of having made the pupil examined [1] the eyes opening greatly, and the non-mydriasis observation which does not perform medication but observes in the condition that the pupil examined [1] the eyes is the usual magnitude are adopted by prescribing a medicine for the subject. Among these, in mydriasis observation, since the pupil examined [1] the eyes is greatly open, even if it enlarges a light guide include angle, it reaches to eyegrounds examined [1] the eyes, without the illumination light being interrupted by the iris. However, in non-mydriasis observation, since the pupil examined [1] the eyes is small, if a light guide include angle is enlarged

like the case where it is mydriasis observation, the illumination light will be interrupted by the iris and will not reach to eyegrounds examined [1] the eyes.

[0005] In order to make the illumination light reach to eyegrounds examined [1] the eyes and to make the flare small as much as possible from these things, for that, it is necessary to carry out the light guide of the illumination light at the light guide include angle which was suitable at the time of each observation, and to change a light guide include angle, respectively the case of mydriasis observation, and in the case of non-mydriasis observation.

[0006] However, the case of mydriasis observation, and in the case of non-mydriasis observation, since the reflective mirror 104 of an illumination-light study system was being fixed to the location distant from the optical axis 105 of observation optical system, the light guide include angle was unchangeable in the ophthalmology observation equipment like the large ophthalmoscope shown in drawing 18, respectively. For this reason, the user needed to hold both the large ophthalmoscope of a light guide include angle suitable for mydriasis observation, and the large ophthalmoscope of a light guide include angle suitable for non-mydriasis observation. Or since it was necessary to perform mydriasis observation and a light guide include angle was not able to take greatly in this case with the large ophthalmoscope suitable for for example, non-mydriasis observation when both large ophthalmoscopes cannot be held, the flare arose and there were problems, like observation becomes difficult.

[0007] Moreover, although the light guide include angle needed to be made small in non-mydriasis observation as mentioned above, there was a case where the flare becomes large as described above when a light guide include angle is made small, observation light became muddy and observation became difficult. However, in the conventional large ophthalmoscope, especially the means for decreasing the flare was not established, but the improvement was demanded from the user.

[0008] This invention aims at offering the ophthalmology observation equipment which it was made [equipment] in order to solve the trouble in said conventional ophthalmology observation equipment, and a light guide include angle can be changed [equipment], and can decrease the flare.

[0009]

[Means for Solving the Problem] In order to solve the trouble in such conventional ophthalmology observation equipment this invention according to claim 1 The observation optical system which has the observation section which observes optometry-ed through an objective lens, and the focussing lens which makes the image examined [said] the eyes focus to this observation section, It is the include angle from which the optical axis of said observation optical system differs the illumination light from the source of the illumination light which emits the illumination light, and this source of the illumination light. And in ophthalmology observation equipment equipped with the illumination-light study system which has the light guide means led to said optometry-ed through said objective lens, said light guide means is moved and it constitutes as a description having had an include-angle modification means to change the light guide include angle of the illumination light to said optometry-ed.

[0010] Moreover, this invention according to claim 2 is constituted in this invention according to claim 1 considering the ability to change said include-angle modification means into the include angle for which it was suitable in order to illuminate eyegrounds examined [of a mydriasis condition] the eyes of said light guide include angle, or the include angle for which it was suitable in order to illuminate eyegrounds examined [of a non-mydriasis condition] the eyes freely as a description.

[0011] moreover, eyegrounds set this invention according to claim 3 to this invention according to claim 1 or 2, and examined [said] the eyes in said illumination-light study system and abbreviation -- it constitutes as a description having had the radiation field diaphragm which has the first of a configuration and the second opening from which it is and differs for narrowing down the lighting range of said illumination light to a location [****] mutually.

[0012] moreover -- the time of this invention according to claim 4 being changed into the include angle for which it was suitable in order that said light guide include angle might illuminate eyegrounds examined [of a mydriasis condition] the eyes with said include-angle modification means in this invention according to claim 3 -- the first opening of said radiation field diaphragm -- minding -- the lighting range of the illumination light -- a rat tail -- and So that the lighting range of the illumination

light may be narrowed down through the second opening of said radiation field diaphragm, in case it is changed into the include angle for which it was suitable in order that said light guide include angle might illuminate eyegrounds examined [of a non-mydriasis condition] the eyes with said include-angle modification means It constitutes as a description having had a interlocking means to interlock said include-angle modification means and said radiation field diaphragm.

[0013] Moreover, in this invention according to claim 1 to 4, this invention according to claim 5 has a pupil diameter measurement means for measuring the pupil diameter examined the eyes, and it constitutes as a description having a calculation means to compute said light guide include angle based on the measurement result of this pupil diameter measurement means, and the control means which controls said include-angle modification means based on the light guide include angle computed with said calculation means.

[0014] Moreover, the observation section in which this invention according to claim 6 observes optometry-ed through an objective lens, It is the include angle from which the optical axis of said observation optical system differs the illumination light from the observation optical system which has the focussing lens which makes the image examined [said] the eyes focus to this observation section, the source of the illumination light which emits the illumination light, and this source of the illumination light. And it sets to ophthalmology observation equipment equipped with the illumination-light study system which has the light guide means led to said optometry-ed through said objective lens. The perpendicular include angle of the optical axis of said illumination light by said light guide means and the optical axis of said observation optical system to make is set up so that it may be suitable in order to illuminate eyegrounds examined [of a non-mydriasis condition / said] the eyes. In the 1st flat surface which contains said perpendicular include angle so that it may be suitable in order to illuminate eyegrounds examined [of a mydriasis condition / said] the eyes, and the 2nd flat surface which carries out an abbreviation rectangular cross It constitutes having established an include-angle modification means by which the level include angle of the optical axis of said illumination light by said light guide means and the optical axis of said observation optical system to make could be set up as a description.

[0015]

[Embodiment of the Invention] Hereafter, the first operation gestalt of the ophthalmology observation equipment concerning this invention is explained to a detail with reference to a drawing. The top view in which the top view and drawing 2 which shows the whole ophthalmology observation equipment configuration [in / in drawing 1 / this operation gestalt] show the side elevation of the ophthalmology observation equipment of drawing 1 , and drawing 3 R> 3 shows the observation condition of a mydriasis eye, drawing 4 , the top view in which drawing 5 shows the observation condition of a non-mydriasis eye, drawing in which drawing 6 shows the include-angle modification section of the ophthalmology observation equipment of drawing 1 , drawing 7 , and drawing 8 are drawings shown focusing on a radiation field diaphragm.

[0016] In drawing 1 , this ophthalmology observation equipment is constituted as a large ophthalmoscope for observing eyegrounds examined [1] the eyes, and is equipped with the illumination-light study system 10 and the observation optical system 20. The illumination-light study system 10 consists of the source 11 of the illumination light which emits the illumination light, radiation field diaphragm 12 which extracts the illumination light to the predetermined range, a relay lens 13, and a light guide means slack reflective mirror 14 for reflecting the illumination light, as shown in drawing 2 . It is emitted in the source 11 of the illumination light, and the light guide of the illumination light is carried out to the predetermined range towards the optometry 1-ed through a rat tail, a relay lens 13, the reflective mirror 14, and an objective lens 21 by passing the openings 12a-12c which the radiation field diaphragm 12 mentions later. The source 11 of these illumination light, the radiation field diaphragm 12, the relay lens 13, the reflective mirror 14, and the objective lens 21 are dedicated by one in the case 15.

[0017] Moreover, the observation optical system 20 consists of an objective lens 21, a focussing lens 23, and an observation section slack ocular 22 for observing the optometry 1-ed through an objective lens 21 and a focussing lens 23. The light (following, "reflected light") which the light guide was carried out to the optometry 1-ed by the illumination-light study system 10, and was reflected by eyegrounds

examined [1] the eyes passes along an objective lens 21, and focuses to a ** person's eye through an ocular 22 by migration in the direction of an optical axis of a focussing lens 23. The case 15 which dedicated these objective lenses 21, the focussing lens 23, the ocular 22, and the illumination-light study system 10 is dedicated by one in the case 24.
[0018] As shown at drawing 1 between the optical axis of the illumination light reflected towards the optometry 1-ed by the reflective mirror 14 shown in drawing 2 here, and the optical axis of the observation optical system 20, the light guide include angle theta is formed in the horizontal plane including the optical axis of the observation optical system 20 (inside of the same field as the drawing 1 space). Therefore, incidence of the illumination light which was reflected by the reflective mirror 14 and led to the optometry 1-ed through the objective lens 21 is carried out to eyegrounds examined [1] the eyes in different include-angle theta' from the optical axis of the observation optical system 20 (the light guide include angle of the illumination light in the interior examined [1] the eyes is hereafter distinguished from the light guide include angle of the illumination light before reflecting "'" by the reflective mirror 14 by giving and expressing).
[0019] In order to change light guide include-angle theta' by changing the above-mentioned light guide include angle theta in this ophthalmology observation equipment, the include-angle modification means slack include-angle modification section 30 is formed (the detail of the include-angle modification section 30 is mentioned later). Concretely, light guide include-angle theta' is changed into the light guide include angle theta'2 (theta'1>theta'2), when observing the optometry 1-ed of a non-mydriasis condition at the light guide include angle theta'1, in observing the optometry 1-ed of a mydriasis condition. The observation condition of a mydriasis eye is shown in drawing 3 . In this drawing 3 , a mydriasis condition has the optometry 1-ed, and the path of the pupil surrounded in that iris 1a is large, and carries out the light guide of the illumination light to the optometry 1-ed at the light guide include angle theta'1. It is reflected by eyegrounds examined [1] the eyes, and the illumination light (in drawing 3 - drawing 5 , a sign S1 shows the illumination light) by which the light guide was carried out at the light guide include angle theta'1 reaches the exterior examined [1] the eyes as an observation light (in drawing 3 - 5, a sign S2 shows observation light).
[0020] Moreover, the observation condition of a non-mydriasis eye is shown in drawing 4 . In this drawing 4 , a non-mydriasis condition has the optometry 1-ed, and it is that iris 1a. The path of the pupil surrounded is small and is in the condition that not much large light guide include-angle theta' cannot be taken. For this reason, the light guide of the illumination light is carried out at the light guide include angle theta'2 smaller than the light guide include angle theta'1.
[0021] Thus, a change to theta'2 or theta'1 from theta'2 from the light guide include angle theta'1 is made by changing the light guide include angle theta into theta 1 to theta 2, or theta 1 from theta 2 by the include-angle modification section 30. This include-angle modification section 30 is arranged among cases 15 and 24, as shown in drawing 2 . Drawing 6 (a) is important section drawing of longitudinal section of the include-angle modification section 30, and drawing 6 (b) is the top view of the include-angle modification section 30. In drawing 6 (a), the include-angle modification section 30 consists of a rotation means slack revolving shaft 31 and a control lever 32. A revolving shaft 31 penetrates cases 15 and 24, and is engaged free [rotation] to a case 24 in a case 15. The revolving shaft 31 is arranged at P points of the focal location of an objective lens 21, i.e., drawing 1 . Protruded towards the case 24 from the case 15, it is made to expose outside through the slot 33 which prepared the point in the case 24, and the control lever 32 is made operational from the outside. This slot 33 is formed in the shape of [centering on the center of rotation of a revolving shaft] radii, as shown in drawing 6 (b), and it can change by moving a control lever 32 along a slot 33, the include angle theta, i.e., the light guide include angle, to the optometry 1-ed of the reflective mirror 14 in a case 15.
[0022] Especially, since it is desirable in this ophthalmology observation equipment that it can position easily at these two include angles well if modification to theta1 and theta2 is possible for the light guide include angle theta, the click section 40 for positioning is formed. the solid sphere always pressed at a case 24 side by the spring 42 prepared in one pore 41 prepared in the case 15, and this pore 41 as this click section 40 was shown in drawing 6 (a), and this spring 42 -- as shown in 43 and drawing 6 (b), it

consists of four stop pores 44-47 prepared in the case 24.
[0023] the solid sphere pressed by the spring 42 -- 43 makes either of the stop pores 44-47 stop that edge, the rotation actuation to the case 24 of a case 15 is regulated by this stop, and positioning is performed. Here, four stop pores 44-47 are formed in the location which sets a light guide include angle to theta1, theta2, -theta2, and -theta1 (the include angle of minus "-" shows the include angle which becomes symmetrical [the include angle of plus] to the optical axis of the observation optical system 20), respectively. For example, as shown in drawing 6 (b), a light guide include angle is set to theta 1 in the condition of having made the stop pore 44 stopping a solid sphere, and where the stop pore 45 is stopped, a light guide include angle is set to theta 2.
[0024] Now, it is mentioned that the configuration for decreasing the flare is prepared as a description of the ophthalmology observation equipment in this operation gestalt. Hereafter, this configuration is explained. In observation of the mydriasis eye first shown in drawing 3 , since light guide include-angle theta' can be enlarged enough as mentioned above, a good observation image is obtained. On the other hand, in observation of the non-mydriasis eye shown in drawing 4 , it is necessary to carry out incidence of the illumination light from a small pupil diameter, and to make light guide include-angle theta' small. Consequently, the part with which the range where observation light and the illumination light overlap, and a lens front face lap becomes large, and the flare arises by reflection of this lens front face (in drawing 4 , a sign F2 shows the lap part on the duplication range of observation light and the illumination light leading to this flare, and the front face of a lens). This flare makes observation light muddy white, and makes observation difficult.
[0025] As here shows the ophthalmology observation equipment in this operation gestalt to drawing 2 , the radiation field diaphragm 12 is established between the source 11 of the illumination light, and the reflective mirror 14. This radiation field diaphragm 12 is shown in drawing 7 (a). In this drawing 7 (a), the radiation field diaphragm 12 is formed in circular tabular, and two circular openings 12a and 12b and opening 12c of one hemicycle are formed of notching Lycium chinense in that part, among these infrared transparency filter 12d is inserted in opening 12b. This radiation field diaphragm 12 is made pivotable as a core in the revolving shaft of that core, and this rotation enables it to arrange alternatively either of the openings 12a-12c at the lower part of the source 11 of the illumination light.
[0026] In the condition that opening 12a has been arranged down the source 11 of the illumination light as shown in drawing 7 (a) the illumination light emitted from the source 11 of the illumination light as the center position of this opening 12a and the center position of the illumination light from the source 11 of the illumination light corresponded, therefore it was shown in drawing 7 (b) -- mostly, all pass the radiation field diaphragm 12, and result in the reflective mirror 14, and a light guide is carried out towards the optometry 1-ed. This condition is in the condition shown in drawing 3 and drawing 4 .
[0027] moreover, the case where opening 12b has been arranged down the source 11 of the illumination light -- the center position of this opening 12b, and the center position of the illumination light from the source 11 of the illumination light -- corresponding -- the illumination light -- all result in the reflective mirror 14 mostly. Since infrared transparency filter 12d is merely inserted in dehiscence regio-oralis 12b, the illumination light turns into infrared light, and passes the radiation field diaphragm 12, and a light guide is carried out to the optometry 1-ed. This infrared light is observable in the condition that a pupil diameter is large, also in a non-mydriasis eye by using for observation the image sensor which is not made to sense dazzle for the subject compared with the usual illumination light, therefore has sensibility in infrared light.
[0028] In the condition that opening 12c has been arranged down the source 11 of the illumination light on the other hand as shown in drawing 8 (a) As the center position of the straight-line side of this opening 12c and the illumination-light center position from the source 11 of the illumination light correspond, therefore it is shown in drawing 8 (b) It is interrupted by the radiation field diaphragm 12 and cannot pass, but only the illumination light of abbreviation one half passes the radiation field diaphragm 12, the abbreviation one half of the illumination light emitted from the source 11 of the illumination light results in the reflective mirror 14, and a light guide is carried out towards the optometry 1-ed. This condition is shown in drawing 5 .

[0029] In this drawing 5 , like drawing 4 , the optometry 1-ed is a non-mydriasis eye, and a light guide include angle is theta'2 again. However, since opening 12c of the radiation field diaphragm 12 was used as mentioned above unlike drawing 4 , the illumination light S1 serves as width of face (width of face in the direction of the drawing 4 space) of abbreviation one half. Specifically, the width of face to the eyegrounds core of the illumination light S1 which reaches eyegrounds examined [1] the eyes is L1 in drawing 5 to being L1+L1=2L1 in drawing 4 R> 4. For this reason, as shown in drawing 5 , the flare produced by duplication on the illumination light S1, the observation light S2, and a lens front face has not arisen. Therefore, the observation light S2 is not made muddy by the flare, and good observation is attained. However, when the illumination light S1 is made into half width of face as mentioned above, an observation field also serves as half.
[0030] Although the description slack include-angle modification section 30 of this operation gestalt and the radiation field diaphragm 12 were explained until now, respectively, these functions are not separate and the effectiveness is further demonstrated by corresponding mutually. That is, although a light guide include angle is set to theta'1 and observation of it with a high field angle is enabled at the time of mydriasis eye observation, since it is not necessary to extract the illumination light to one half according to the radiation field diaphragm 12 in this case, or to make it infrared light, opening 12a is used among the openings 12a-12c of the radiation field diaphragm 12. On the other hand, at the time of non-mydriasis eye observation, when a light guide include angle is set to theta'2, in order to extract the illumination light to one half and to decrease the flare, opening 12c of the radiation field diaphragm 12 is used. However, even if it is at the non-mydriasis eye observation time, since the pupil diameter examined [1] the eyes is large and observation with a high field angle is possible when making the illumination light into infrared light by opening 12b of the radiation field diaphragm 12, a light guide include angle is set to theta'1 by the include-angle modification section 30.
[0031] Moreover, although illustration is omitted, these include-angles modification section 30 and the radiation field diaphragm 12 interlock according to a well-known interlock. For example, when the include-angle modification section 30 is operated by the control lever, actuation of this include-angle modification section 30 may be sensed in a position sensor, and the radiation field diaphragm 12 may be automatically rotated in motorised according to these contents of sensing. In the condition that form the switch for changing the two modes, "general observation mode" and "infrared observation mode", for example to this equipment, and "general observation mode" is chosen by this switch if this ganged operation is explained more concretely When you make automatically opening 12a of the radiation field diaphragm 12 into a busy condition by linkage when a light guide include angle is set to theta'1, and referred to as theta'2, let opening 12c be a busy condition automatically by linkage. Moreover, when "infrared observation mode" is chosen, while setting a light guide include angle to theta'1 automatically, opening of the radiation field diaphragm 12 is automatically set to 12b.
[0032] Next, the second operation gestalt of the ophthalmology observation equipment concerning this invention is explained. However, especially about a part without explanation, a same sign shows the same component as the first operation gestalt like the above-mentioned first operation gestalt. Drawing 9 is the side elevation showing this whole operation gestalt configuration. After the illumination light emitted in this drawing 9 from the source 11 of the illumination light of the illumination-light study system 10 is extracted by the radiation field diaphragm 12, it is reflected in reflective mirror 14a or reflective mirror 14b, and the light guide of it is carried out to the optometry 1-ed at a different include angle from the optical axis of the observation optical system 20.
[0033] As shown in drawing 9 here, incidence of the illumination light reflected in reflective mirror 14a is carried out to an objective lens 21 at the light guide include angle theta 1, it carries out incidence to the optometry 1-ed after that, and reaches eyegrounds examined [1] the eyes at the light guide include angle theta'1. Moreover, incidence of the illumination light reflected in reflective mirror 14b is carried out to an objective lens 21 at the light guide include angle theta 2, it carries out incidence to the optometry 1-ed after that, and reaches eyegrounds examined [1] the eyes at the light guide include angle theta'2. In this operation gestalt, by using it in this way, changing the reflective mirrors 14a and 14b mutually, the light guide include angle theta is changed and, as a result, light guide include-angle

theta' is changed.
[0034] Drawing 10 is the conceptual diagram of the include-angle modification section 50 in this operation gestalt, and the condition that (a) is using reflective mirror 14b, and the condition that (b) is using reflective mirror 14a are shown. The include-angle modification section 30 is first shown in drawing 11 as a perspective view. As shown in this drawing 11 , the include-angle modification section 30 fixes two reflective mirrors 14a and 14b to a substrate 51, and is formed, and this substrate 51 is supported pivotable considering the revolving shaft 52 as a core. Either of two reflective mirrors 14a and 14b can be alternatively arranged on the optical axis of the source 11 of the illumination light by rotating this substrate 51.
[0035] As shown in drawing 10 (a), when reflective mirror 14b has been arranged on the optical axis of the source 11 of the illumination light, the arrangement location and include angle of reflective mirror 14b are determined so that the light guide of the illumination light may be carried out by this reflective mirror 14b at the light guide include angle theta 1. Moreover, as shown in drawing 10 (b), when reflective mirror 14a has been arranged on the optical axis of the source 11 of the illumination light, the arrangement location and include angle of reflective mirror 14a are determined so that the light guide of the illumination light may be carried out by this reflective mirror 14a at the light guide include angle theta 2. This include-angle modification section 50 is driven with the drive motor which engaged with the revolving shaft 52 of a substrate 51 and which is not illustrated, and either of the reflective mirrors 14a and 14b is arranged on the optical axis of the source 11 of the illumination light.
[0036] Next, the third operation gestalt of the ophthalmology observation equipment concerning this invention is explained. However, especially about a part without explanation, a same sign shows the same component as the first operation gestalt like the above-mentioned first operation gestalt. drawing 12 -- a book -- operation -- a gestalt -- it can set -- ophthalmology -- observation -- equipment -- the whole -- a configuration -- being shown -- a top view -- drawing 13 -- drawing 12 -- ophthalmology -- observation -- equipment -- a side elevation -- drawing 14 -- mentioning later -- a light guide -- an include angle -- H -- theta -- ' -- V -- theta -- ' -- G -- theta -- ' -- mutual -- relation -- explaining -- a sake -- drawing -- it is .
[0037] In this gestalt, a light guide is possible in the illumination light at light guide include-angle Gtheta compounded from light guide include-angle Htheta (level include angle) formed in a horizontal plane including the optical axis of the observation optical system 20 (inside of the same field as the drawing 12 space), and light guide include-angle (perpendicular include angle) Vtheta formed in a vertical plane including the optical axis of observation optical system (inside of a perpendicular field to the drawing 12 space). If the include-angle modification section 30 is formed like the first operation gestalt, light guide include-angle Htheta is formed of this in the horizontal plane which includes the optical axis of the observation optical system 20 as shown in drawing 12 and only the inside of a horizontal plane is specifically considered, incidence of the illumination light will be carried out to eyegrounds examined [1] the eyes by light guide include-angle Htheta'. Moreover, in this ophthalmology observation equipment, if light guide include-angle Vtheta within the vertical plane which includes the optical axis of the observation optical system 20 by arranging the reflective mirror 14 of the illumination-light study system 10 to the optical axis of the observation optical system 20 at the method of drawing Nakagami is formed and only the inside of a vertical plane is considered as shown in drawing 13 , incidence of the illumination light will be carried out to eyegrounds examined [1] the eyes by light guide include-angle Vtheta'. Therefore, in fact, the light guide of the illumination light is carried out in light guide include-angle Gtheta which comes to compound light guide include-angle Htheta and light guide include-angle Vtheta, and it carries out incidence to eyegrounds examined [1] the eyes by Gtheta'.
[0038] these -- V -- theta -- ' -- H -- theta -- ' -- G -- theta -- ' -- mutual -- relation -- drawing 14 -- referring to -- explaining . Now, in drawing 14 , the X-axis and a horizontal plane are expressed for the optical axis of observation optical system, and eyegrounds examined [a X-Z flat surface and / 1] the eyes are expressed for a X-Y flat surface and a vertical plane as origin of coordinates. And if X-Z flat-surface and light guide include-angle Htheta' is expressed for light guide include-angle Vtheta' to a X-Y

flat surface, respectively, light guide include-angle Gtheta' will become like illustration. here -- these -- V -- theta -- ' -- H -- theta -- ' -- G -- theta -- ' -- mutual -- **** -- [Equation 1] from illustration

$$\left(2\sin\frac{G\theta}{2}\right)^2 = \left(2\sin\frac{V\theta}{2}\right)^2 + \left(2\sin\frac{H\theta}{2}\right)^2 \quad \cdots\cdots\cdots\cdots \text{式 } 1$$

****** arises.

[0039] Here, as shown in drawing 13 , in this gestalt, light guide include-angle Vtheta is being fixed to the light guide include angle theta 2 suitable for non-mydriasis observation, and modification only of light guide include-angle Htheta of drawing 12 is enabled by the include-angle modification section 30. Therefore, it can become light guide include-angle Htheta=0, then light guide include-angle G theta=V theta=theta 2 by the include-angle modification section 30 first, namely, can be set to light guide include-angle Gtheta'=Vtheta'=theta'2, and incidence of the illumination light can be carried out to eyegrounds examined [1] the eyes at the light guide include angle theta'2 suitable for non-mydriasis observation. Moreover, incidence of the illumination light can be carried out to eyegrounds examined [1] the eyes at the light guide include angle theta'1 which an include angle which fills the following formula 2, then the light guide include angle were set to theta 1, therefore was suitable for mydriasis observation in light guide include-angle Htheta with the include-angle modification section 30.

[Equation 2]

$$\left(2\sin\frac{\theta 1}{2}\right)^2 = \left(2\sin\frac{\theta 2}{2}\right)^2 + \left(2\sin\frac{H\theta}{2}\right)^2 \quad \cdots\cdots\cdots\cdots \text{式 } 2$$

[0040] Thus, in this gestalt, while light guide include-angle Vtheta is fixed to the light guide include angle theta 2, the light guide include angle suitable for non-mydriasis observation and the light guide include angle suitable for mydriasis observation can be switched by changing light guide include-angle Htheta into an include angle which fills 0 or a formula 2.

[0041] Since the light guide include angle theta 2 is what is set up as a light guide include angle suitable for non-mydriasis observation here, it is desirable that it is the include angle which the incidence of the illumination light can be carried out to a non-powder pupil, and does not interrupt the flux of light of observation optical system, i.e., the reflected light. Specifically, the light guide include angle theta 2 is set as about 6 times to the optical axis of the observation optical system 20. It is desirable that it is the include angle which it can carry out [include angle] incidence of the illumination light to a powder pupil since the light guide include angle theta 1 is what is set up as a light guide include angle suitable for mydriasis observation, and does not produce the flare as much as possible on the other hand. That is, it is set as the maximum include angle among the include angles which can carry out incidence of the illumination light to a powder pupil. The light guide include angle theta 1 specifically compounded when light guide include-angle Htheta is made into about 13 degrees for the light guide include angle theta 2 to the optical axis of the observation optical system 20 about 6 times to the optical axis of the observation optical system 20 becomes what was most suitable for mydriasis observation. [0042] suitable for mydriasis observation thus, the light guide include angle theta -- 2 = about 6 times and the light guide include angle H -- the concrete basis made into theta = about 13 degrees is explained. Drawing 17 is drawing for explaining the relation between a light guide include angle and a pupil diameter. In this drawing 17 , the chain line shows an objective lens and the optical axis examined the eyes, and a continuous line shows a light guide path. Moreover, H shows [a pupil include angle] the radius of the pupil examined [L and] the eyes for the focal distance of theta and an objective lens. The focal distances L at the time of using the objective lens of lens frequency 90D here are L= 1000 / 90 = about 11.1mm. first -- theta -- 2 = about 6 times and the light guide include angle H -- if it assumes that it is theta = about 13 degrees, it will become theta1=14.3 degree from a formula 2. if it is H=Ltan theta in drawing 17 here and L= 11.1 and theta= 6 times are substituted for this formula -- a pupil radius -- H = about 1.2mm It becomes. The value of this pupil radius H is the pupil radius of about 1-1.5mm at the time of the non-mydriasis obtained experientially. theta 2 since it corresponds = it turns out that the illumination light by which the pupil was carried out at about 6 times can carry out incidence to a non-

mydriasis eye. Moreover, if L= 11.1 and whenever [theta= 14.3] are substituted for the formula of H=Ltan theta, it is 2.8mm of pupil radius H= abbreviation. It becomes. Htheta since the value of this pupil radius H corresponds to the pupil radius of 2.5-4mm at the time of the mydriasis obtained experientially = it turns out that the incidence of the illumination light can be carried out to a mydriasis eye at the time of about 13 degrees.
[0043] Next, the fourth operation gestalt of the ophthalmology observation equipment concerning this invention is explained. However, especially about a part without explanation, a same sign shows the same component as the first operation gestalt like the above-mentioned first operation gestalt. Drawing 15 is the side elevation of the pupil diameter test section 60. Drawing 15 is omitted and shown although the same illumination-light study system 10 as the first operation gestalt, the observation optical system 20, and the include-angle modification section 30 are formed also in this operation gestalt. As shown in this drawing 15 , in this gestalt, the pupil diameter test section 60 for measuring the pupil diameter examined [1] the eyes is formed. This pupil diameter test section 60 consists of a source 61 of a measuring beam, and a lens 62 and a line sensor 63, and the measuring beam floodlighted in the source 61 of a measuring beam reflects in the front face examined [1] the eyes, and it is received with a line sensor 63 through a lens 62. In addition, since it is removable as a noise component even if the illumination light which infrared light is used for the measuring beam in this gestalt, therefore was reflected by eyegrounds examined [1] the eyes carries out incidence to a line sensor 63, it can measure correctly.
[0044] Drawing 16 is the explanatory view showing mutual relation, such as a line sensor examined the eyes in pupil diameter measurement, and line sensor light income. A line sensor 63 is for receiving the measuring beam reflected in the front face examined [1] the eyes, and measuring the pupil diameter examined [1] the eyes based on the light income, and as it is installed and constituted by the width of face which carried out abbreviation correspondence at iris 1a examined [1] the eyes and two or more image sensors are shown in the drawing 16 upper part, it is arranged so that the center position of the cross direction may be equivalent to the abbreviation center position of pupil 1b. The relation between the light income measured with this line sensor 63 and the location examined [1] the eyes is shown in the drawing 16 lower part. As shown in this drawing 16 , there are few measuring beams reflected in pupil 1b examined [1] the eyes compared with the measuring beam reflected in iris 1a, therefore since the light income of the part corresponding to pupil 1b decreases among the light income measured with the line sensor 63, the pupil diameter examined [1] the eyes can be measured by detecting the width of face W of a part with little this light income.
[0045] It computes with a light guide include-angle calculation means which does not illustrate prepared the light guide include angle which incidence is carried out [include angle] from the optimal light guide include angle for observation, i.e., a pupil, based on the pupil diameter examined [which was measured by the pupil diameter test section 60 in this way / 1] the eyes, and does not produce the flare as much as possible in this equipment, and the include-angle modification section 30 controls in this operation gestalt by the control means which prepared in this equipment so that the light guide of the illumination light might be carried out at this light guide include angle and which does not illustrate. Therefore, even when changing the pupil diameter examined [1] the eyes according to individual difference etc., it can illuminate at the always optimal light guide include angle, and optimal observation can always be performed automatically.
[0046] now, the thing which may be carried out with a gestalt which this invention is not limited to the operation gestalt shown above, but is variously different within the limits of the technical thought although the first of this invention - the fourth operation gestalt were explained until now -- it is -- the following -- ******** -- a gestalt is explained. Although the case where ophthalmology observation equipment was a large ophthalmoscope was explained in the above-mentioned operation gestalt, this invention may be applied to all the ophthalmology observation equipments. Moreover, the include-angle modification section 30 may not be restricted to the above-mentioned thing, but may be materialized using all the devices of common knowledge, such as a servo motor.
[0047] Moreover, although the case where a light guide include angle was made into the light guide

include angle theta'1 for mydriasis observation or the light guide include angle theta'2 for non-mydriasis observation was explained, it is not restricted to these two include angles, for example, you may enable it to take continuously the include angle to zero - 45 degrees. Moreover, it is not necessarily required, and even if the radiation field diaphragm 12 is the case where the radiation field diaphragm 12 is established, it does not interlock this radiation field diaphragm 12 with the include-angle modification section 30, and is good also as independently operational.
[0048] Moreover, although the line sensor 63 was used in order to measure the pupil diameter examined [1] the eyes in the fourth operation gestalt, the image examined [1] the eyes may be picturized with a common CCD camera, and a pupil diameter may be measured by carrying out the image processing of this image.
[0049]
[Effect of the Invention] As described above, this invention of claim 1 and six publications moves a light guide means, by having had an include-angle modification means to change the light guide include angle of the illumination light to optometry-ed etc., can carry out the light guide of the illumination light at the most suitable include angle according to conditions, such as mydriasis examined the eyes and non-mydriasis, and can be observed in the optimal condition.
[0050] Furthermore, this invention according to claim 2 can carry out the light guide of the illumination light at the most suitable include angle according to conditions, such as mydriasis examined the eyes and non-mydriasis, especially by the ability to change into the include angle for which it was suitable in order that an include-angle modification means might illuminate eyegrounds examined [of a mydriasis condition] the eyes of a light guide include angle, or the include angle for which it was suitable in order to illuminate eyegrounds examined [of a non-mydriasis condition] the eyes freely.
[0051] and eyegrounds examined [this invention according to claim 3 / said] the eyes in an illumination-light study system and abbreviation -- by having had the radiation field diaphragm which has the first of a configuration and the second opening from which it is and differs for narrowing down the lighting range of the illumination light to a location [****] mutually When a light guide include angle is small, by minding a radiation field diaphragm, generating of the flare can be suppressed and much more good observation can be performed.
[0052] In case it is changed into the include angle for which it was suitable in order that, as for this invention according to claim 4, a light guide include angle might illuminate eyegrounds examined [of a mydriasis condition] the eyes with an include-angle modification means, the first opening of a radiation field diaphragm is minded again. The lighting range of the illumination light And a rat tail, And so that the lighting range of the illumination light may be narrowed down through the second opening of a radiation field diaphragm, in case it is changed into the include angle for which it was suitable in order that a light guide include angle might illuminate eyegrounds examined [of a non-mydriasis condition] the eyes with an include-angle modification means Since the time and effort which a light guide include angle and opening of a radiation field diaphragm interlock mutually, and is manually interlocked by having had a interlocking means to interlock an include-angle modification means and a radiation field diaphragm can be saved, it can observe still more easily.
[0053] Furthermore, by having a pupil diameter measurement means for measuring the pupil diameter examined the eyes, and having a calculation means compute a light guide include angle based on the measurement result of this pupil diameter measurement means, and the control means which controls said include-angle modification means based on the light guide include angle computed with the calculation means, the optimal light guide include angle to optometry-ed is computed automatically, and this invention according to claim 5 can optimize observation conditions automatically.

[Translation done.]

DESCRIPTION OF DRAWINGS

[Brief Description of the Drawings]
[Drawing 1] It is the top view showing the configuration of the ophthalmology observation equipment in the first operation gestalt of this invention.
[Drawing 2] It is the side elevation showing the whole ophthalmology observation equipment configuration of drawing 1 .
[Drawing 3] It is the top view showing the observation condition of a mydriasis eye.
[Drawing 4] In the observation condition of a non-mydriasis eye, it is the top view showing the condition that the illumination light is not extracted.
[Drawing 5] In the observation condition of a non-mydriasis eye, it is the top view showing the condition that the illumination light was extracted.
[Drawing 6] It is drawing showing the include-angle modification section 30 of the ophthalmology observation equipment of drawing 1 , and (a) is important section drawing of longitudinal section, and (b) is an important section top view.
[Drawing 7] It is drawing shown focusing on the radiation field diaphragm 12 of the ophthalmology observation equipment of drawing 1 , and (a) is a perspective view and (b) is a side elevation.
[Drawing 8] It is drawing shown focusing on the radiation field diaphragm 12 of the ophthalmology observation equipment of drawing 1 , and (a) is a perspective view and (b) is a side elevation.
[Drawing 9] It is the top view showing the configuration of the ophthalmology observation equipment in the second operation gestalt of this invention.
[Drawing 10] It is drawing showing the include-angle modification section 30 of the ophthalmology observation equipment of drawing 9 , and an important section side elevation in case (a) considers as the light guide include angle theta'2, and (b) are the important section side elevations in the case of considering as the light guide include angle theta'1.
[Drawing 11] It is the perspective view of the include-angle modification section 30 of the ophthalmology observation equipment of drawing 9 .
[Drawing 12] It is the top view showing the configuration of the ophthalmology observation equipment in the third operation gestalt of this invention.
[Drawing 13] It is the side elevation of the ophthalmology observation equipment of drawing 12 .
[Drawing 14] a light guide -- an include angle -- H -- theta -- ' -- V -- theta -- ' -- G -- theta -- ' -- mutual -- relation -- being shown -- an explanatory view -- it is .
[Drawing 15] It is the side elevation of a pupil diameter test section.
[Drawing 16] It is the explanatory view showing mutual relation, such as a line sensor examined the eyes in pupil diameter measurement, and line sensor light income.
[Drawing 17] It is drawing for explaining the relation between a light guide include angle and a pupil diameter.
[Drawing 18] It is the block diagram of the conventional large ophthalmoscope.
[Description of Notations]
1 Optometry-ed

10 Illumination-Light Study System
11 Source of Illumination Light
12 Radiation Field Diaphragm
13 Relay Lens
14 Reflective Mirror
20 Observation Optical System
21 Objective Lens
22 Ocular
23 Focussing Lens
30 Include-Angle Modification Section
40 Click Section
60 Pupil Diameter Test Section

[Translation done.]

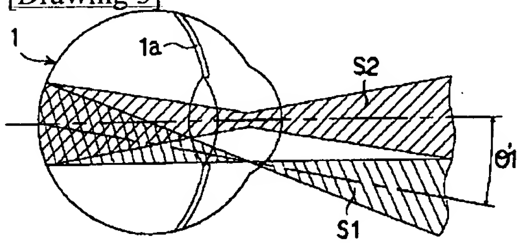
* NOTICES *

JPO and NCIPI are not responsible for any damages caused by the use of this translation.

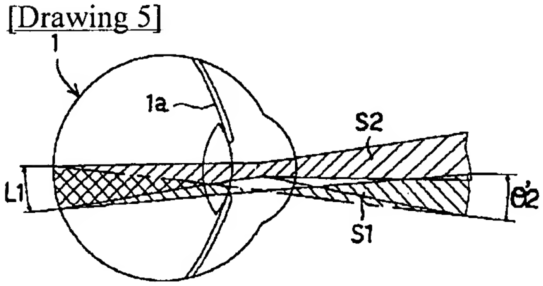
1.This document has been translated by computer. So the translation may not reflect the original precisely.
2.**** shows the word which can not be translated.
3.In the drawings, any words are not translated.

DRAWINGS

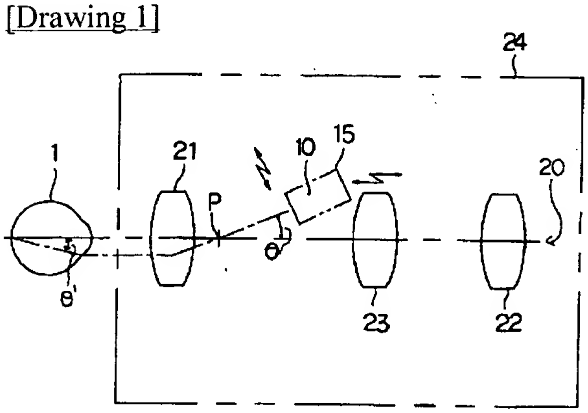
[Drawing 3]



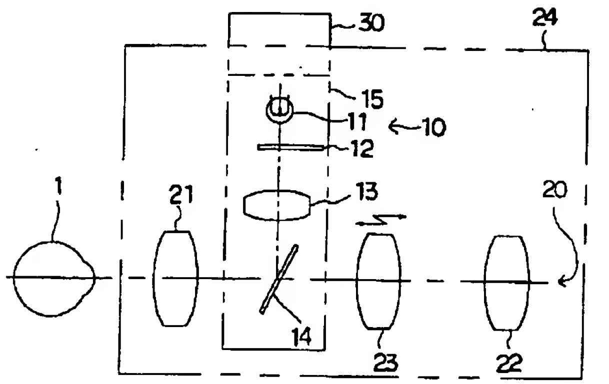
[Drawing 5]



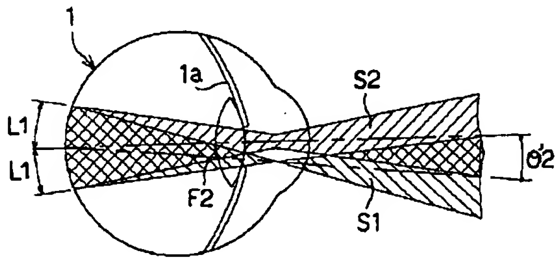
[Drawing 1]



[Drawing 2]

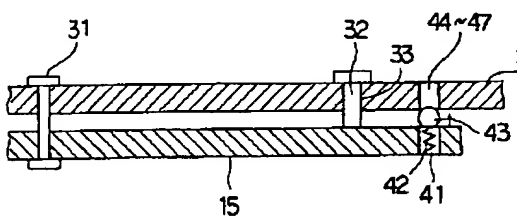


[Drawing 4]

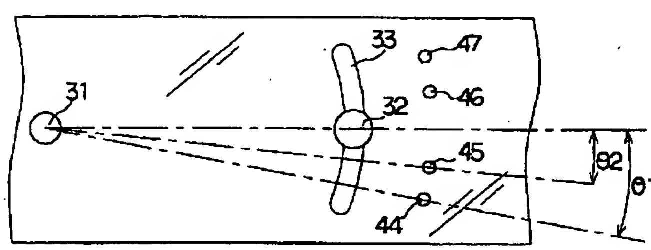


[Drawing 6]

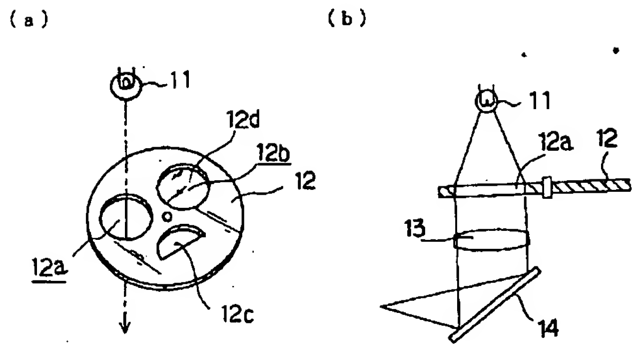
(a)



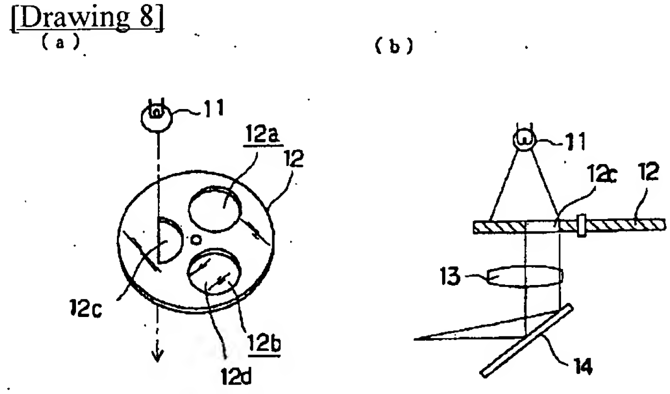
(b)



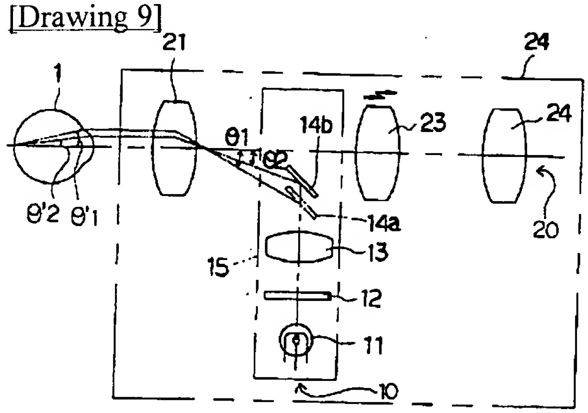
[Drawing 7]



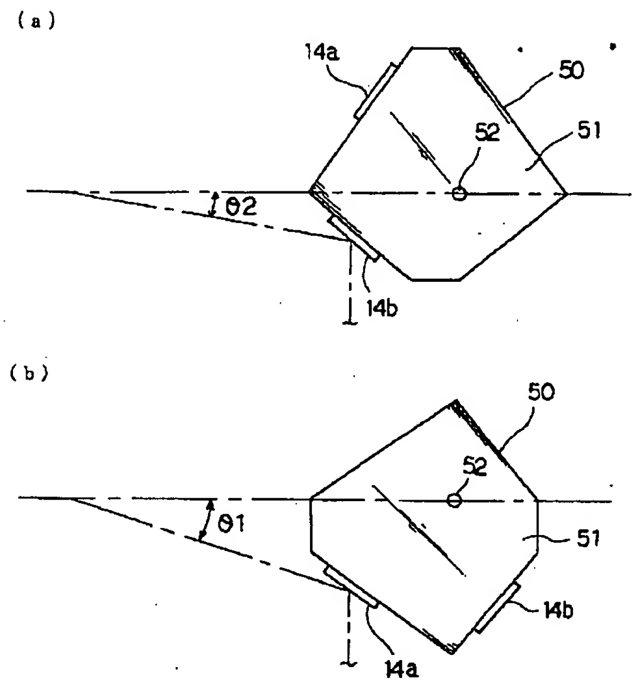
[Drawing 8]



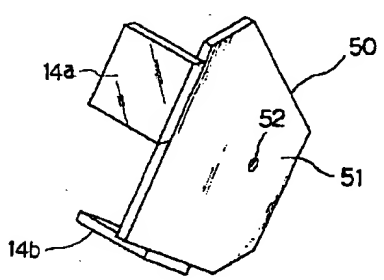
[Drawing 9]



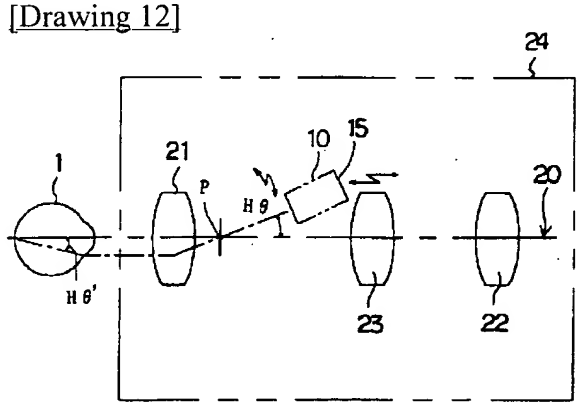
[Drawing 10]



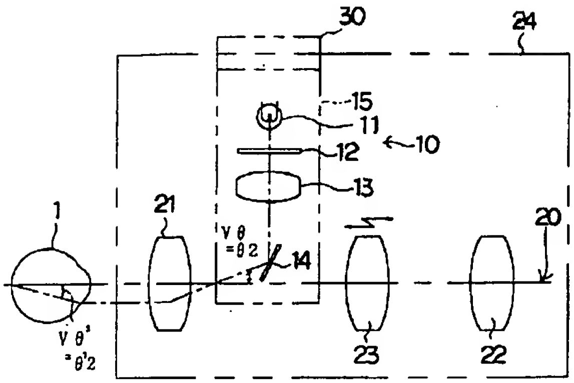
[Drawing 11]



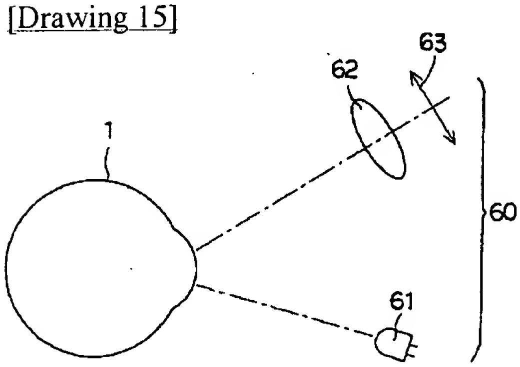
[Drawing 12]



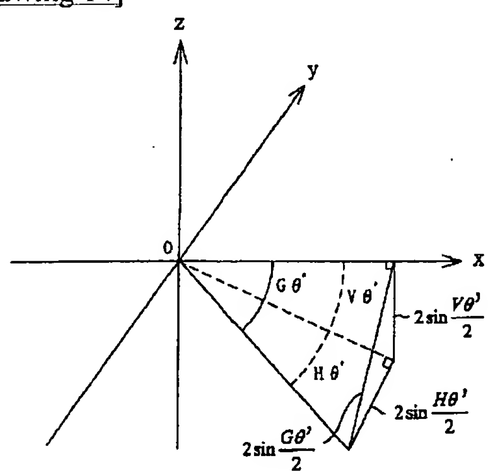
[Drawing 13]



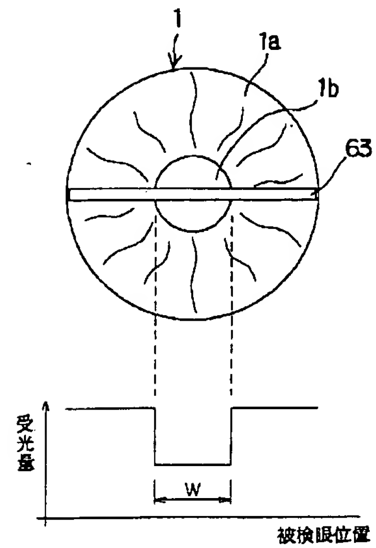
[Drawing 15]



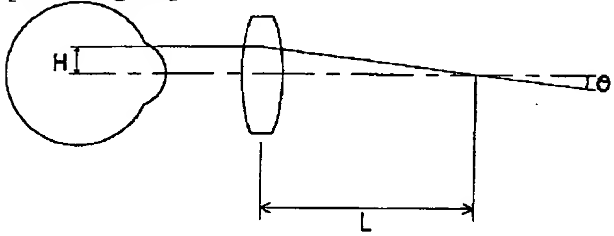
[Drawing 14]



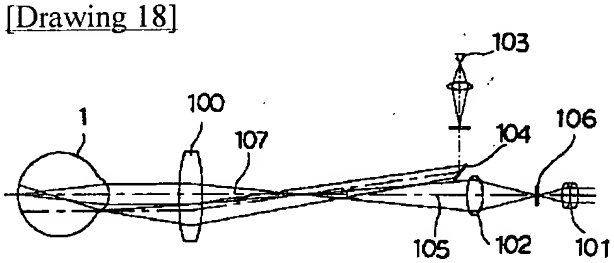
[Drawing 16]



[Drawing 17]



[Drawing 18]



[Translation done.]

(19)日本国特許庁（JP）　(12)公開特許公報（A）　(11)特許出願公開番号
特開平11－89798
(43)公開日　平成11年(1999)4月6日

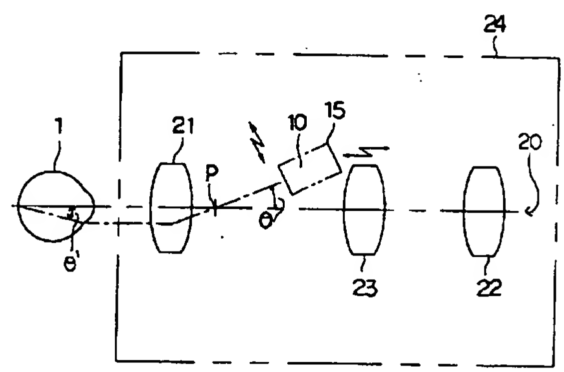
(51)Int.Cl.⁶	識別記号	FI	
A61B　3/14		A61B　3/14	C

審査請求　未請求　請求項の数6　FD　（全11頁）

(21)出願番号　特願平9－272050
(22)出願日　平成9年(1997)9月18日
(71)出願人　000004112
株式会社ニコン
東京都千代田区丸の内3丁目2番3号
(72)発明者　高橋　嘉裕
東京都千代田区丸の内3丁目2番3号　株式会社ニコン内
(72)発明者　富岡　研
東京都千代田区丸の内3丁目2番3号　株式会社ニコン内
(72)発明者　金子　雅信
東京都千代田区丸の内3丁目2番3号　株式会社ニコン内
(74)代理人　弁理士　村田　幹雄　（外1名）
最終頁に続く

(54)【発明の名称】　眼科観察装置

(57)【要約】
【課題】　内焦式かつ傾斜照明式の眼科観察装置において、導光角度を変更することができ、またフレアを減少させることのできる眼科観察装置を提供することを目的とする。
【解決手段】　対物レンズ21を介して被検眼1を観察する観察部と、該観察部に対し被検眼1の像を合焦させる合焦レンズ23とを有する観察光学系20と、照明光を発する照明光源11と、該照明光源11からの照明光を反射して観察光学系20の光軸とは異なる角度で、かつ対物レンズ21を介して被検眼1に導光する反射ミラー14とを有する照明光学系10とを備えた眼科観察装置において、反射ミラー14を移動させることにより、被検眼1に対する照明光の導光角度θを変更するよう反射ミラー14の位置を変える角度変更部30を備える。



【特許請求の範囲】

【請求項１】対物レンズを介して被検眼を観察する観察部と、該観察部に対し前記被検眼の像を合焦させる合焦レンズとを有する観察光学系と、

照明光を発する照明光源と、該照明光源からの照明光を前記観察光学系の光軸とは異なる角度で、かつ前記対物レンズを介して前記被検眼に導く導光手段とを有する照明光学系と、を備えた眼科観察装置において、

前記導光手段を移動させ、前記被検眼に対する照明光の導光角度を変更する角度変更手段、を備えたことを特徴とする眼科観察装置。

【請求項２】前記角度変更手段は、前記導光角度を、散瞳状態の被検眼の眼底を照明するために適した角度か、無散瞳状態の被検眼の眼底を照明するために適した角度のいずれかに変更自在であること、を特徴とする請求項１記載の眼科観察装置。

【請求項３】前記照明光学系中における前記被検眼の眼底と略共役な位置に、前記照明光の照明範囲を絞るためのもので互いに異なる形状の第一及び第二の開口部を有する照野絞り、を備えたことを特徴とする請求項１又は２記載の眼科観察装置。

【請求項４】前記角度変更手段にて前記導光角度が散瞳状態の被検眼の眼底を照明するために適した角度に変更される際には前記照野絞りの第一の開口部を介して照明光の照明範囲が絞られ、かつ、前記角度変更手段にて前記導光角度が無散瞳状態の被検眼の眼底を照明するために適した角度に変更される際には前記照野絞りの第二の開口部を介して照明光の照明範囲が絞られるよう、前記角度変更手段と前記照野絞りとを連動させる連動手段、を備えたことを特徴とする請求項３記載の眼科観察装置。

【請求項５】被検眼の瞳孔径を測定するための瞳孔径測定手段を有し、該瞳孔径測定手段の測定結果に基づいて前記導光角度を算出する算出手段と、

前記算出手段で算出された導光角度に基づいて前記角度変更手段を制御する制御手段と、を備えることを特徴とする請求項１乃至４記載の眼科観察装置。

【請求項６】対物レンズを介して被検眼を観察する観察部と、該観察部に対し前記被検眼の像を合焦させる合焦レンズとを有する観察光学系と、

照明光を発する照明光源と、該照明光源からの照明光を前記観察光学系の光軸とは異なる角度で、かつ前記対物レンズを介して前記被検眼に導く導光手段とを有する照明光学系と、を備えた眼科観察装置において、

無散瞳状態の前記被検眼の眼底を照明するために適するように前記導光手段による前記照明光の光軸と前記観察光学系の光軸とのなす垂直角度を設定し、散瞳状態の前記被検眼の眼底を照明するために適するように前記垂直角度を含む第１平面と略直交する第２平面内で、前記導光手段による前記照明光の光軸と前記観察光学系の光軸とのなす水平角度を設定可能な角度変更手段を設けたこと、を特徴とする眼科観察装置。

【発明の詳細な説明】

【０００１】

【発明の属する技術分野】本発明は、被検眼を観察するための眼科観察装置に関し、特に被検眼に対する照明を行うための構造に特徴を有する眼科観察装置に関する。

【０００２】

【従来の技術】被検眼の眼底を観察するための眼科観察装置には、倒像鏡、直像鏡等、種々のものがある。このような眼科観察装置のうち、合焦方式が装置内部の合焦レンズをその光軸方向に移動させて行う内焦式であり、かつ、被検眼に対する照明方式が照明光を観察光学系の光軸とは異なる角度で被検眼に導光する傾斜照明式であるものが提供されており、これは一般に大検眼鏡と呼ばれている。この大検眼鏡は、図１８に示すように、対物レンズ１００と、この対物レンズ１００及び合焦レンズ１０２を介して被検眼１を観察するための接眼レンズ１０１と、焦点鏡１０６とを有する観察光学系と、照明光を発する照明光源１０３、照明光源１０３の照明光を被検眼１に向け反射する反射ミラー１０４とを有する照明光学系とを備えて構成されている。照明光学系の反射ミラー１０４は、照明光源１０３からの照明光を観察光学系の光軸１０５とは異なる角度にて被検眼１に導光する。

【０００３】

【発明が解決しようとする課題】一般に、観察光学系の光軸１０５と、照明光学系の光軸１０７とのなす角度（以下、単に「導光角度」とする）が小さくなると、照明光束と観察光束との重複範囲が大きくなり、この重複範囲と被検眼１の水晶体表面とが重なって生ずるフレアも大きくなる。このようにフレアが大きくなると、該フレアによって観察光が濁されて観察が困難になるため、導光角度を極力大きくとり、フレアを生じさせないことが望ましい。

【０００４】ここで被検眼１の眼底を観察する場合、被検者に投薬することにより被検眼１の瞳孔を大きく開かせた状態で観察を行う散瞳観察と、投薬を行わず被検眼１の瞳孔が通常の大きさである状態で観察を行う無散瞳観察との２つの観察方法が採用されている。このうち散瞳観察においては、被検眼１の瞳孔が大きく開いているため、導光角度を大きくしても、照明光が虹彩に遮られることなく被検眼１の眼底まで到達する。しかし、無散瞳観察においては、被検眼１の瞳孔が小さいため、散瞳観察の場合と同様に導光角度を大きくすると、照明光が虹彩に遮られて被検眼１の眼底まで到達しない。

【０００５】これらのことから、照明光を被検眼１の眼底まで到達させ、かつ、フレアを極力小さくするためには、各観察時に適した導光角度で照明光を導光する必要があり、このためには、散瞳観察の場合と無散瞳観察の

場合とでそれぞれ導光角度を変える必要がある。

【0006】しかしながら図１８に示す大検眼鏡の如き眼科観察装置においては、照明光学系の反射ミラー１０４は観察光学系の光軸１０５から離れた位置に固定されていたので、散瞳観察の場合と無散瞳観察の場合とでそれぞれ導光角度を変えることができなかった。このためユーザーは、散瞳観察に適した導光角度の大検眼鏡と無散瞳観察に適した導光角度の大検眼鏡の両方を保有する必要があった。あるいは両方の大検眼鏡を保有できない場合には、例えば無散瞳観察に適した大検眼鏡で散瞳観察を行う必要があり、この場合、導光角度が大きくとれないために、フレアが生じて観察が困難になる等の問題があった。

【0007】また上記のように無散瞳観察においては導光角度を小さくする必要があるが、導光角度を小さくした場合には上記したようにフレアが大きくなり、観察光が濁って観察が困難になる場合があった。しかしながら従来の大検眼鏡においては、フレアを減少するための手段は特に設けられておらず、ユーザーから改善が要望されていた。

【0008】本発明は、前記従来の眼科観察装置における問題点を解決するためになされたもので、導光角度を変更することができ、またフレアを減少させることのできる眼科観察装置を提供することを目的とする。

【0009】

【課題を解決するための手段】このような従来の眼科観察装置における問題点を解決するために請求項１記載の本発明は、対物レンズを介して被検眼を観察する観察部と、該観察部に対し前記被検眼の像を合焦させる合焦レンズとを有する観察光学系と、照明光を発する照明光源と、該照明光源からの照明光を前記観察光学系の光軸とは異なる角度で、かつ前記対物レンズを介して前記被検眼に導く導光手段とを有する照明光学系とを備えた眼科観察装置において、前記導光手段を移動させ、前記被検眼に対する照明光の導光角度を変更する角度変更手段を備えたことを特徴として構成されている。

【0010】また請求項２記載の本発明は、請求項１記載の本発明において、前記角度変更手段は、前記導光角度を、散瞳状態の被検眼の眼底を照明するために適した角度か、無散瞳状態の被検眼の眼底を照明するために適した角度のいずれかに変更自在であることを特徴として構成されている。

【0011】また請求項３記載の本発明は、請求項１又は２記載の本発明において、前記照明光学系中における前記被検眼の眼底と略共役な位置に、前記照明光の照明範囲を絞るためのもので互いに異なる形状の第一及び第二の開口部を有する照野絞りを備えたことを特徴として構成されている。

【0012】また請求項４記載の本発明は、請求項３記載の本発明において、前記角度変更手段にて前記導光角度が散瞳状態の被検眼の眼底を照明するために適した角度に変更される際には前記照野絞りの第一の開口部を介して照明光の照明範囲が絞られ、かつ、前記角度変更手段にて前記導光角度が無散瞳状態の被検眼の眼底を照明するために適した角度に変更される際には前記照野絞りの第二の開口部を介して照明光の照明範囲が絞られるよう、前記角度変更手段と前記照野絞りとを連動させる連動手段を備えたことを特徴として構成されている。

【0013】また請求項５記載の本発明は、請求項１乃至４記載の本発明において、被検眼の瞳孔径を測定するための瞳孔径測定手段を有し、該瞳孔径測定手段の測定結果に基づいて前記導光角度を算出する算出手段と、前記算出手段で算出された導光角度に基づいて前記角度変更手段を制御する制御手段とを備えることを特徴として構成されている。

【0014】また請求項６記載の本発明は、対物レンズを介して被検眼を観察する観察部と、該観察部に対し前記被検眼の像を合焦させる合焦レンズとを有する観察光学系と、照明光を発する照明光源と、該照明光源からの照明光を前記観察光学系の光軸とは異なる角度で、かつ前記対物レンズを介して前記被検眼に導く導光手段とを有する照明光学系とを備えた眼科観察装置において、無散瞳状態の前記被検眼の眼底を照明するために適するように前記導光手段による前記照明光の光軸と前記観察光学系の光軸とのなす垂直角度を設定し、散瞳状態の前記被検眼の眼底を照明するために適するように前記垂直角度を含む第１平面と略直交する第２平面内で、前記導光手段による前記照明光の光軸と前記観察光学系の光軸とのなす水平角度を設定可能な角度変更手段を設けたことを特徴として構成されている。

【0015】

【発明の実施の形態】以下、本発明に係る眼科観察装置の第一実施形態について図面を参照して詳細に説明する。図１は本実施形態における眼科観察装置の全体構成を示す平面図、図２は図１の眼科観察装置の側面図、図３は散瞳眼の観察状態を示す平面図、図４、図５は無散瞳眼の観察状態を示す平面図、図６は図１の眼科観察装置の角度変更部を示す図、図７、図８は照野絞りを中心に示す図である。

【0016】図１において本眼科観察装置は、被検眼１の眼底を観察するための大検眼鏡として構成されており、照明光学系１０と観察光学系２０とを備えている。照明光学系１０は、図２に示すように、照明光を発する照明光源１１と、照明光を所定の範囲に絞る照野絞り１２と、リレーレンズ１３と、照明光を反射するための導光手段たる反射ミラー１４とから構成されている。照明光源１１にて発せられて照明光は、照野絞り１２の後述する開口部１２ａ～１２ｃを通過することによって所定範囲に絞られ、リレーレンズ１３，反射ミラー１４、対物レンズ２１を介して被検眼１に向けて導光される。こ

れら照明光源11、照野絞り12、リレーレンズ13、反射ミラー14及び対物レンズ21は、筐体15内に一体に納められている。

【0017】また観察光学系20は、対物レンズ21と、合焦レンズ23と、対物レンズ21及び合焦レンズ23を介して被検眼1を観察するための観察部たる接眼レンズ22とから構成されている。照明光学系10にて被検眼1に導光され、被検眼1の眼底で反射された光（以下、「反射光」）は、対物レンズ21を通り、合焦レンズ23の光軸方向への移動により接眼レンズ22を介して検者の眼に合焦される。これら対物レンズ21、合焦レンズ23、接眼レンズ22及び照明光学系10を納めた筐体15は、筐体24内に一体に納められている。

【0018】ここで図2に示す反射ミラー14にて被検眼1に向け反射される照明光の光軸と、観察光学系20の光軸との間には、図1に示すように、観察光学系20の光軸を含む水平面内（図1紙面と同一面内）において導光角度θが形成されている。したがって、反射ミラー14にて反射され対物レンズ21を通って被検眼1へ導かれた照明光は、観察光学系20の光軸とは異なる角度θ’にて被検眼1の眼底に入射する（以下、被検眼1の内部における照明光の導光角度を「’」を付して表すことにより、反射ミラー14にて反射される前の照明光の導光角度と区別する）。

【0019】本眼科観察装置においては上記導光角度θを変更することによって導光角度θ’を変更するため、角度変更手段たる角度変更部30が設けられている（角度変更部30の詳細は後述する）。具体的に導光角度θ’は、散瞳状態の被検眼1を観察する場合には導光角度θ’1に、無散瞳状態の被検眼1を観察する場合には導光角度θ’2（θ’1＞θ’2）に変更される。図3には散瞳眼の観察状態を示す。この図3において、被検眼1は散瞳状態にあり、その虹彩1aにて囲まれる瞳孔の径が大きく、導光角度θ’1にて照明光を被検眼1に導光する。導光角度θ’1で導光された照明光（図3～図5において照明光を符号S1にて示す）は、被検眼1の眼底で反射され、観察光（図3～5において観察光を符号S2にて示す）として被検眼1の外部に至る。

【0020】また図4には無散瞳眼の観察状態を示す。この図4において、被検眼1は無散瞳状態にあり、その虹彩1aにて囲まれる瞳孔の径が小さく、導光角度θ’をあまり大きくとることができない状態である。このため照明光は、導光角度θ’1よりも小さな導光角度θ’2で導光されている。

【0021】このように導光角度θ’1からθ’2へ、あるいはθ’2からθ’1への変更は、角度変更部30によって導光角度θをθ1からθ2へ、あるいはθ2からθ1へ変更することにより行われている。この角度変更部30は、図2に示すように、筐体15、24の間に配置されている。図6（a）は角度変更部30の要部縦断面図、図6（b）は角度変更部30の平面図である。図6（a）において、角度変更部30は、回転手段たる回転軸31及び操作レバー32にて構成されている。回転軸31は、筐体15、24を貫通し、筐体15を筐体24に対して回転自在に係合するものである。回転軸31は対物レンズ21の焦点位置、すなわち図1のP点に配置されている。操作レバー32は筐体15から筐体24に向け突設されたもので、その先端部を筐体24に設けた溝部33を介して外部に露出させ、外部から操作可能とされている。この溝部33は図6（b）に示すように回転軸の回転中心を中心とした円弧状に形成されており、操作レバー32を溝部33に沿って動かすことにより、筐体15内の反射ミラー14の被検眼1に対する角度すなわち導光角度θを変更することができる。

【0022】特に本眼科観察装置においては、導光角度θはθ1とθ2とに変更可能であればよく、またこれら2つの角度に容易に位置決めできることが望ましいので、位置決めを行うためのクリック部40が設けられている。このクリック部40は、図6（a）に示すように、筐体15に設けた1つの孔部41、該孔部41内に設けたスプリング42、該スプリング42にて筐体24側に常時押圧される球体43、及び、図6（b）に示すように、筐体24に設けた4つの係止孔部44～47から構成されている。

【0023】スプリング42にて押圧された球体43はその端部を係止孔部44～47のいずれかに係止させ、この係止によって筐体15の筐体24に対する回転動作が規制されて位置決めが行われる。ここで、4つの係止孔部44～47は、それぞれ導光角度をθ1、θ2、－θ2、－θ1（マイナス「－」の角度は、観察光学系20の光軸に対しプラスの角度とは対称となる角度を示す）とする位置に形成されている。例えば、図6（b）に示すように、係止孔部44に球体を係止させた状態では導光角度はθ1となり、係止孔部45に係止させた状態では導光角度はθ2となる。

【0024】さて、本実施形態における眼科観察装置の特徴として、フレアを減少させるための構成が設けられていることが挙げられる。以下、この構成について説明する。まず図3に示す散瞳眼の観察においては、前述のように導光角度θ’を十分大きくできるので、良好な観察像が得られる。一方、図4に示す無散瞳眼の観察においては、小さな瞳孔径から照明光を入射する必要があり、導光角度θ’を小さくする必要がある。その結果、観察光と照明光とが重複する範囲と、水晶体表面とが重なる部分が大きくなり、この水晶体表面の反射によってフレアが生ずる（このフレアの原因となる観察光と照明光の重複範囲と、水晶体表面との重なり部分を図4において符号F2にて示す）。このフレアは、観察光を白く濁して、観察を困難にする。

【0025】ここで本実施形態における眼科観察装置においては、図2に示すように、照明光源11と反射ミラー14との間に照野絞り12が設けられている。この照野絞り12を図7（a）に示す。この図7（a）において照野絞り12は、円形板状に形成され、その一部を切欠くことによって円形の2つの開口部12a、12bと1つの半円形の開口部12cとが形成されており、このうち開口部12bには赤外透過フィルタ12dが嵌め込まれている。この照野絞り12はその中心の回転軸を中心として回転可能とされており、この回転によって開口部12a～12cのいずれかを照明光源11の下方に選択的に配置できるようにされている。

【0026】図7（a）に示すように、開口部12aが照明光源11の下方に配置された状態においては、この開口部12aの中心位置と照明光源11からの照明光の中心位置とが対応し、したがって、図7（b）に示すように、照明光源11から発せられた照明光のほぼ全部が照野絞り12を通過して反射ミラー14に至り、被検眼1に向けて導光される。この状態が図3、図4に示した状態である。

【0027】また開口部12bを照明光源11の下方に配置した場合も、該開口部12bの中心位置と照明光源11からの照明光の中心位置とが対応し、照明光のほぼ全部が反射ミラー14に至る。ただし開口部12bには赤外透過フィルタ12dが嵌め込まれているため、照明光は赤外光となって照野絞り12を通過し、被検眼1に導光される。この赤外光は、通常の照明光に比べて被検者に眩しさを感じさせず、したがって赤外光に感度を持つ撮像素子を観察に用いることにより無散瞳眼においても瞳孔径の大きい状態で観察を行うことができる。

【0028】一方、図8（a）に示すように、開口部12cが照明光源11の下方に配置された状態において、この開口部12cの直線辺の中心位置と照明光源11からの照明光中心位置とが対応し、したがって図8（b）に示すように、照明光源11から発せられた照明光の略半分は照野絞り12に遮られて通過できず、略半分の照明光のみ照野絞り12を通過して反射ミラー14に至り、被検眼1に向けて導光される。この状態を図5に示す。

【0029】この図5において、図4と同様に被検眼1は無散瞳眼でありまた導光角度はθ’2である。ただし図4と異なり、上記のように照野絞り12の開口部12cを用いたため、照明光S1が略半分の幅（図4紙面方向における幅）となっている。具体的には、被検眼1の眼底に到達する照明光S1の眼底中心に対する幅は、図4ではL1＋L1＝2L1であるのに対し、図5ではL1である。このため図5に示すように、照明光S1と観察光S2と水晶体表面との重複により生ずるフレアが生じていない。したがって観察光S2がフレアによって濁されることがなく、良好な観察が可能となる。ただし上記のように照明光S1を半分の幅とした場合、観察領域も半分となる。

【0030】これまで本実施形態の特徴たる角度変更部30と照野絞り12とについてそれぞれ説明したが、これらの機能は別個のものでなく互いに対応することによって、その効果を一層発揮するものである。すなわち散瞳眼観察時には、導光角度がθ’1とされ高画角での観察が可能とされるが、この場合には照野絞り12によって照明光を半分に絞ったり、赤外光にする必要がないため、照野絞り12の開口部12a～12cのうち開口部12aが使用される。一方、無散瞳眼観察時には、導光角度がθ’2とされた場合には、照明光を半分に絞ってフレアを減少させるために、照野絞り12の開口部12cが使用される。ただし無散瞳眼観察時であっても、照野絞り12の開口部12bによって照明光を赤外光とする場合には被検眼1の瞳孔径が大きく高画角での観察が可能であるため角度変更部30によって導光角度がθ’1とされる。

【0031】また図示は省略するが、これら角度変更部30と照野絞り12とは、周知の連動機構によって連動される。例えば、角度変更部30をその操作レバーによって操作した際、該角度変更部30の動作を位置センサーにて感知し、該感知内容に応じて照野絞り12を自動的にモータ駆動にて回転させてもよい。この連動動作をより具体的に説明すると、例えば本装置に「一般観察モード」と「赤外観察モード」の2つのモードを切り替えるためのスイッチを設け、このスイッチによって「一般観察モード」が選択されている状態で、導光角度がθ’1とされた場合には、照野絞り12の開口部12aを連動により自動的に使用状態とし、θ’2とされた場合には、開口部12cを連動により自動的に使用状態とする。また「赤外観察モード」が選択された場合には、導光角度を自動的にθ’1とすると共に、照野絞り12の開口部を自動的に12bとする。

【0032】次に本発明に係る眼科観察装置の第二実施形態について説明する。ただし、特に説明なき部分については上記した第一実施形態と同様であり、また第一実施形態と同じ構成要素は同符号にて示す。図9は本実施形態の全体構成を示す側面図である。この図9において照明光学系10の照明光源11から発せられた照明光は照野絞り12にて絞られた後、反射ミラー14a又は反射ミラー14bにて反射され、観察光学系20の光軸とは異なる角度にて被検眼1に導光される。

【0033】ここで図9に示すように、反射ミラー14aにて反射された照明光は導光角度θ1にて対物レンズ21に入射し、その後被検眼1に入射して導光角度θ’1で被検眼1の眼底に到達する。また反射ミラー14bにて反射された照明光は導光角度θ2にて対物レンズ21に入射し、その後被検眼1に入射して導光角度θ’2で被検眼1の眼底に到達する。本実施形態においては、

このように反射ミラー14a、14bを相互に切り替えて使用することによって、導光角度θを変更し、その結果導光角度θ’を変更する。

【0034】図10は本実施形態における角度変更部50の概念図であり、（a）は反射ミラー14bを使用している状態、（b）は反射ミラー14aを使用している状態を示す。まず図11には角度変更部30を斜視図として示す。この図11に示すように角度変更部30は、基板51に2つの反射ミラー14a、14bを固定して形成されており、この基板51は回転軸52を中心として回転可能に支持されている。この基板51を回転させることによって2つの反射ミラー14a、14bのいずれかを選択的に照明光源11の光軸上に配置することができる。

【0035】図10（a）に示すように、反射ミラー14bを照明光源11の光軸上に配置した場合に該反射ミラー14bによって照明光が導光角度θ1にて導光されるよう、反射ミラー14bの配置位置及び角度が決定されている。また図10（b）に示すように、反射ミラー14aを照明光源11の光軸上に配置した場合に該反射ミラー14aによって照明光が導光角度θ2にて導光されるよう、反射ミラー14aの配置位置及び角度が決定されている。この角度変更部50は基板51の回転軸52に係合した図示しない駆動モータによって駆動され、反射ミラー14a、14bのいずれかが照明光源11の光軸上に配置される。

【0036】次に本発明に係る眼科観察装置の第三実施形態について説明する。ただし、特に説明なき部分については上記した第一実施形態と同様であり、また第一実施形態と同じ構成要素は同符号にて示す。図12は本実施形態における眼科観察装置の全体構成を示す平面図、図13は図12の眼科観察装置の側面図、図14は後述する導光角度Hθ’、Vθ’、Gθ’相互の関係を説明するための図である。

【0037】本形態においては、観察光学系20の光軸を含む水平面内（図12紙面と同一面内）で形成される導光角度Hθ（水平角度）と、観察光学系の光軸を含む垂直面内（図12紙面に対し垂直な面内）で形成される導光角度（垂直角度）Vθとから合成される導光角度Gθで照明光を導光可能である。具体的には、第一実施形態と同様に角度変更部30が設けられており、これによって図12に示すように、観察光学系20の光軸を含む水平面内において導光角度Hθが形成され、水平面内だけを考えれば照明光は導光角度Hθ’で被検眼1の眼底に入射する。また本眼科観察装置においては、図13に示すように、照明光学系10の反射ミラー14が観察光学系20の光軸に対し図中上方に配置されることによって、観察光学系20の光軸を含む垂直面内における導光角度Vθが形成され、垂直面内だけを考えれば照明光は導光角度Vθ’で被検眼1の眼底に入射する。したがって照明光は、実際には導光角度Hθ及び導光角度Vθを合成してなる導光角度Gθにて導光され、被検眼1の眼底にGθ’で入射する。

【0038】これらVθ’、Hθ’、Gθ’相互の関係を図14を参照して説明する。今、図14において、観察光学系の光軸をX軸、水平面をX－Y平面、垂直面をX－Z平面、被検眼1の眼底を座標原点として表す。そして導光角度Vθ’をX－Z平面、導光角度Hθ’をX－Y平面にそれぞれ表すと、導光角度Gθ’は図示のようになる。ここで、これらVθ’、Hθ’、Gθ’相互には図示から

【数1】

$$\left(2\sin\frac{G\theta}{2}\right)^2=\left(2\sin\frac{V\theta}{2}\right)^2+\left(2\sin\frac{H\theta}{2}\right)^2 \quad \cdots\cdots\cdots\cdots \text{式 1}$$

の関係が生じる。

【0039】ここで、図13に示すように、本形態において、導光角度Vθは無散瞳観察に適した導光角度θ2に固定されており、図12の導光角度Hθのみが角度変更部30によって変更可能とされている。したがって、まず角度変更部30によって導光角度Hθ＝0とすれば、導光角度Gθ＝Vθ＝θ2となり、すなわち導光角度Gθ’＝Vθ’＝θ’2となり、無散瞳観察に適した導光角度θ’2で照明光を被検眼1の眼底に入射させることができる。また角度変更部30によって導光角度Hθを下記の式2を満たすような角度とすれば、導光角度はθ1となり、したがって散瞳観察に適した導光角度θ’1で照明光を被検眼1の眼底に入射させることができる。

【数2】

$$\left(2\sin\frac{\theta 1}{2}\right)^2=\left(2\sin\frac{\theta 2}{2}\right)^2+\left(2\sin\frac{H\theta}{2}\right)^2 \quad \cdots\cdots\cdots\cdots \text{式 2}$$

【0040】このように本形態においては、導光角度Vθを導光角度θ2に固定する一方で、導光角度Hθを0か式2を満たすような角度に変更することにより無散瞳観察に適した導光角度と散瞳観察に適した導光角度とを切り換えることができる。

【0041】ここで、導光角度θ2は無散瞳観察に適した導光角度として設定されるものであるため、無散瞳孔に照明光が入射でき、かつ観察光学系の光束、すなわち反射光を遮らない角度であることが望ましい。具体的には、導光角度θ2は、観察光学系20の光軸に対して約6度に設定されている。一方、導光角度θ1は散瞳観察に適した導光角度として設定されるものであるため、散瞳孔に照明光が入射でき、かつ極力フレアを生じさせない角度であることが望ましい。すなわち、散瞳孔に照明

光が入射できる角度のうち最大の角度に設定される。具体的には、導光角度θ２を観察光学系２０の光軸に対して約６度、導光角度Ｈθを観察光学系２０の光軸に対して約１３度とした場合に合成される導光角度θ１が散瞳観察に最も適したものとなる。散瞳観察に適した

【００４２】このように導光角度θ２＝約６度、導光角度Ｈθ＝約１３度とする具体的根拠について説明する。図１７は、導光角度及び瞳孔径の関係を説明するための図である。この図１７において、対物レンズ及び被検眼の光軸を鎖線にて示し、導光経路を実線にて示す。また瞳孔角度をθ、対物レンズの焦点距離をＬ、被検眼の瞳孔の半径をＨで示す。ここでレンズ度数９０Ｄの対物レンズを使用した場合の焦点距離ＬはＬ＝１０００／９０＝約１１．１㎜である。まずθ２＝約６度、導光角度Ｈθ＝約１３度と仮定すると、式２よりθ１＝14.3度となる。ここで図１７においてＨ＝Ltan θであり、この式にＬ＝１１．１、θ＝６度を代入すると瞳孔半径Ｈ＝約1.2㎜ となる。この瞳孔半径Ｈの値は、経験的に得られた無散瞳時の瞳孔半径約１～1.5㎜ に該当することから、θ２＝約６度で瞳孔された照明光は無散瞳眼に入射できることがわかる。またＨ＝Ltan θの式にＬ＝１１．１、θ＝14.3度を代入すると瞳孔半径Ｈ＝約2.8㎜となる。この瞳孔半径Ｈの値は、経験的に得られた散瞳時の瞳孔半径2.5 ～４㎜に該当することから、Ｈθ＝約１３度のときに照明光が散瞳眼に入射できることがわかる。

【００４３】次に本発明に係る眼科観察装置の第四実施形態について説明する。ただし、特に説明なき部分については上記した第一実施形態と同様であり、また第一実施形態と同じ構成要素は同符号にて示す。図１５は瞳孔径測定部６０の側面図である。本実施形態においても第一実施形態と同じ照明光学系１０、観察光学系２０及び角度変更部３０が設けられているが、図１５においては省略して示す。この図１５に示すように本形態においては、被検眼１の瞳孔径を測定するための瞳孔径測定部６０が設けられている。この瞳孔径測定部６０は、測定光源６１と、レンズ６２及びラインセンサ６３から構成されており、測定光源６１にて投光された測定光が被検眼１の表面に反射し、レンズ６２を経てラインセンサ６３にて受光される。なお本形態における測定光には赤外光が用いられており、したがって被検眼１の眼底で反射した照明光がラインセンサ６３に入射してもノイズ成分として除去できるので、正確に測定を行うことができる。

【００４４】図１６は瞳孔径測定における被検眼、ラインセンサ、ラインセンサ受光量等の相互の関係を示す説明図である。ラインセンサ６３は被検眼１の表面に反射された測定光を受光してその受光量に基づいて被検眼１の瞳孔径を測定するためのもので、複数の撮像素子を被検眼１の虹彩１ａに略対応した幅に並設して構成され、図１６上方に示すように、その幅方向の中心位置が瞳孔１ｂの略中心位置に対応するように配置されている。このラインセンサ６３にて測定された受光量と被検眼１の位置との関係を図１６下方に示す。この図１６に示すように、被検眼１の瞳孔１ｂにて反射される測定光は虹彩１ａにて反射される測定光に比べて少なく、したがってラインセンサ６３にて測定された受光量のうち瞳孔１ｂに対応する部分の受光量が少なくなるため、この受光量の少ない部分の幅Ｗを検出することによって被検眼１の瞳孔径を測定することができる。

【００４５】本実施形態においては、このように瞳孔径測定部６０にて測定された被検眼１の瞳孔径に基づいて観察に最適な導光角度、すなわち瞳孔から入射し、かつフレアを極力生じさせない導光角度を本装置に設けた図示しない導光角度算出手段によって算出し、該導光角度にて照明光が導光されるように本装置に設けた図示しない制御手段にて角度変更部３０を制御する。したがって、被検眼１の瞳孔径が個人差等によって変動する場合でも常に最適な導光角度で照明することができ、最適な観察を常時自動的に行うことができる。

【００４６】さてこれまで本発明の第一～第四実施形態について説明したが、本発明は上記に示した実施形態に限定されず、その技術的思想の範囲内において種々異なる形態にて実施されてよいものであり、以下これら異なる形態について説明する。上記実施形態においては眼科観察装置が大検眼鏡である場合について説明したが、本発明は眼科観察装置の全てに適用されてよい。また角度変更部３０は上記のものに限られず、サーボモータ等の周知のあらゆる機構を用いて具体化されてよい。

【００４７】また導光角度を散瞳観察用の導光角度θ'１か無散瞳観察用の導光角度θ'２とする場合について説明したが、これら２つの角度に限られず、例えば０度～４５度までの角度を連続的に取り得るようにしてもよい。また照野絞り１２は必ずしも必要でなく、また照野絞り１２を設けた場合であっても、この照野絞り１２を角度変更部３０と連動させず、独立に操作可能としてもよい。

【００４８】また第四実施形態において被検眼１の瞳孔径を測定するためにラインセンサ６３を用いたが、この他、一般的なＣＣＤカメラにて被検眼１の像を撮像し、この像を画像処理することによって瞳孔径を測定してもよい。

【００４９】

【発明の効果】上記したように請求項１、６記載の本発明は、導光手段を移動させ、被検眼に対する照明光の導光角度を変更する角度変更手段を備えたこと等により、被検眼の散瞳、無散瞳等の状態に応じて最も適切な角度で照明光を導光することができ、最適な状態で観察を行うことができる。

【００５０】さらに請求項２記載の本発明は、角度変更手段は、導光角度を、散瞳状態の被検眼の眼底を照明す

るために適した角度か、無散瞳状態の被検眼の眼底を照明するために適した角度のいずれかに変更自在であることにより、特に被検眼の散瞳、無散瞳等の状態に応じて最も適切な角度で照明光を導光することができる。

【0051】しかも請求項3記載の本発明は、照明光学系中における前記被検眼の眼底と略共役な位置に、照明光の照明範囲を絞るためのもので互いに異なる形状の第一及び第二の開口部を有する照野絞りを備えたことにより、導光角度が小さい場合においても照野絞りを介することによってフレアの発生を抑えることができ、一層良好な観察を行うことができる。

【0052】しかもまた請求項4記載の本発明は、角度変更手段にて導光角度が散瞳状態の被検眼の眼底を照明するために適した角度に変更される際には照野絞りの第一の開口部を介して照明光の照明範囲が絞られ、かつ、角度変更手段にて導光角度が無散瞳状態の被検眼の眼底を照明するために適した角度に変更される際には照野絞りの第二の開口部を介して照明光の照明範囲が絞られるよう、角度変更手段と照野絞りとを連動させる連動手段とを備えたことにより、導光角度と照野絞りの開口部とが互いに連動され手動で連動させる手間を省くことが出来るので、一層容易に観察を行うことができる。

【0053】さらに請求項5記載の本発明は、被検眼の瞳孔径を測定するための瞳孔径測定手段を有し、該瞳孔径測定手段の測定結果に基づいて導光角度を算出する算出手段と、算出手段で算出された導光角度に基づいて前記角度変更手段を制御する制御手段とを備えることにより、被検眼に対する最適な導光角度が自動的に算出され、観察条件を自動的に最適化することができる。

【図面の簡単な説明】

【図1】本発明の第一実施形態における眼科観察装置の構成を示す平面図である。

【図2】図1の眼科観察装置の全体構成を示す側面図である。

【図3】散瞳眼の観察状態を示す平面図である。

【図4】無散瞳眼の観察状態において、照明光が絞られていない状態を示す平面図である。

【図5】無散瞳眼の観察状態において、照明光が絞られた状態を示す平面図である。

【図6】図1の眼科観察装置の角度変更部30を示す図であり、（a）は要部縦断面図、（b）は要部平面図である。

【図7】図1の眼科観察装置の照野絞り12を中心に示す図であり、（a）は斜視図、（b）は側面図である。

【図8】図1の眼科観察装置の照野絞り12を中心に示す図であり、（a）は斜視図、（b）は側面図である。

【図9】本発明の第二実施形態における眼科観察装置の構成を示す平面図である。

【図10】図9の眼科観察装置の角度変更部30を示す図であり、（a）は導光角度θ’2とする場合の要部側面図、（b）は導光角度θ’1とする場合の要部側面図である。

【図11】図9の眼科観察装置の角度変更部30の斜視図である。

【図12】本発明の第三実施形態における眼科観察装置の構成を示す平面図である。

【図13】図12の眼科観察装置の側面図である。

【図14】導光角度Hθ’、Vθ’、Gθ’相互の関係を示す説明図である。

【図15】瞳孔径測定部の側面図である

【図16】瞳孔径測定における被検眼、ラインセンサ、ラインセンサ受光量等の相互の関係を示す説明図である。

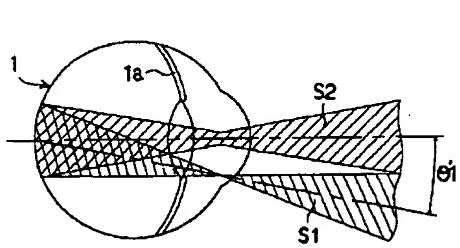
【図17】導光角度及び瞳孔径の関係を説明するための図である。

【図18】従来の大検眼鏡の構成図である。

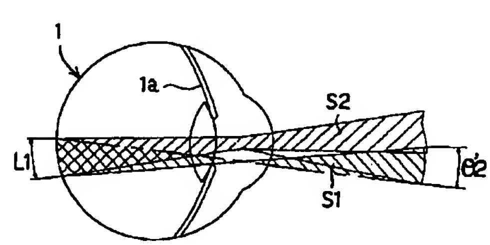
【符号の説明】

1　被検眼
10　照明光学系
11　照明光源
12　照野絞り
13　リレーレンズ
14　反射ミラー
20　観察光学系
21　対物レンズ
22　接眼レンズ
23　合焦レンズ
30　角度変更部
40　クリック部
60　瞳孔径測定部

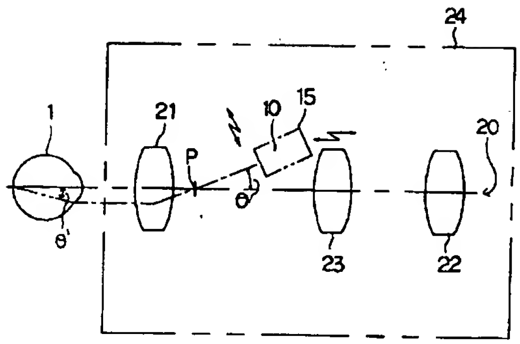
【図3】



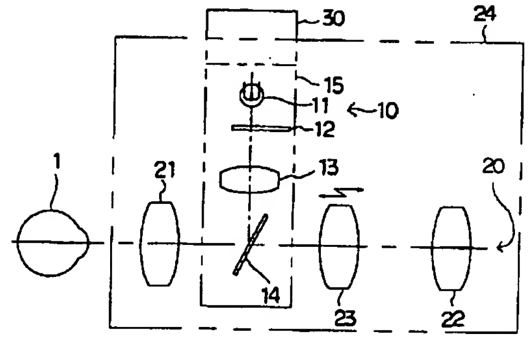
【図5】



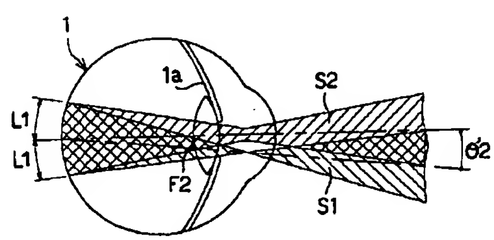
【図1】



【図2】

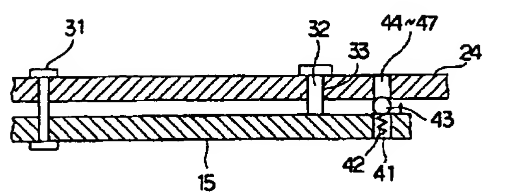


【図4】

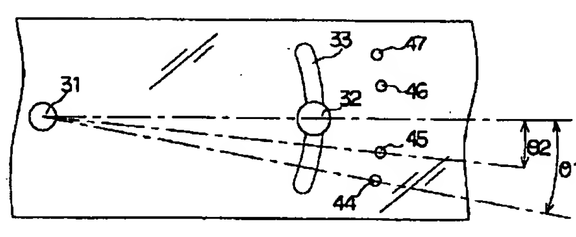


【図6】

（a）

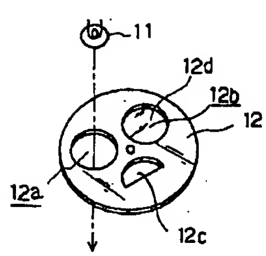


（b）

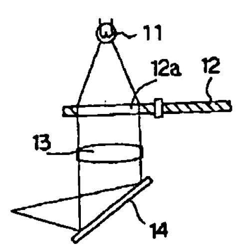


【図7】

（a）

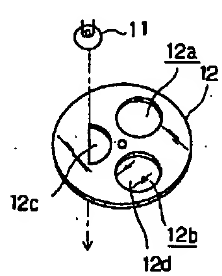


（b）

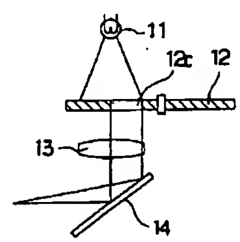


【図8】

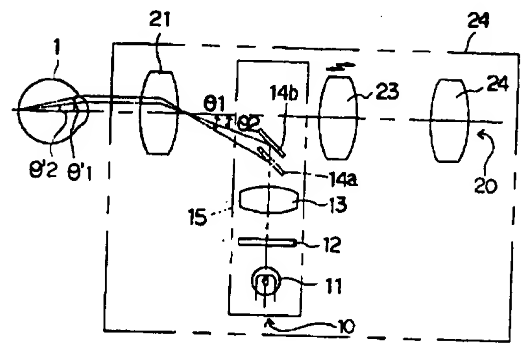
（a）



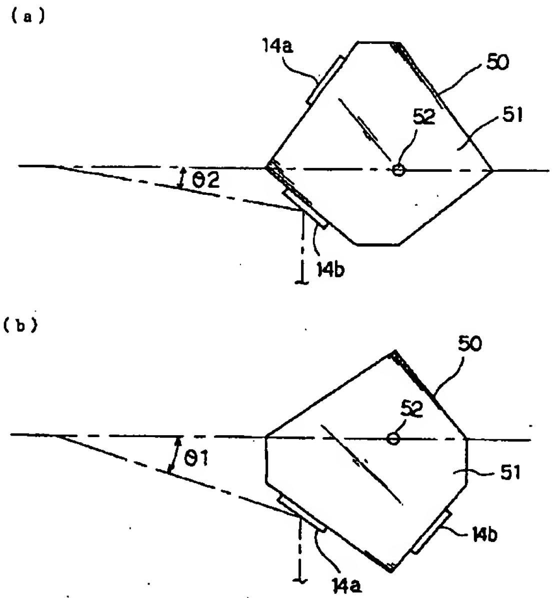
（b）



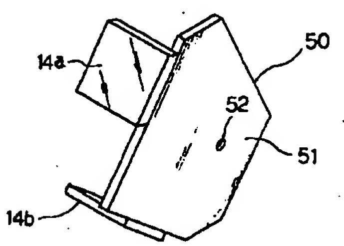
【図9】



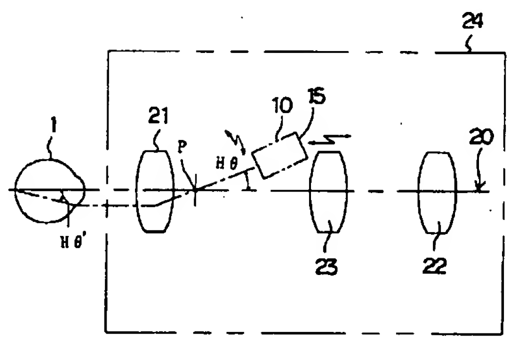
【図10】



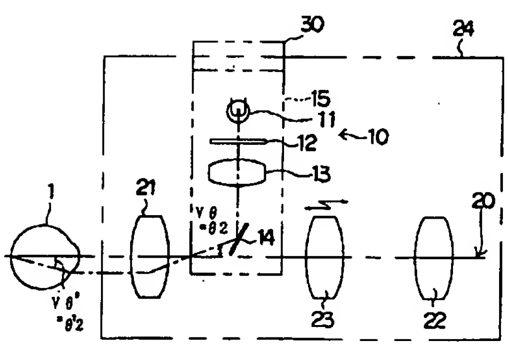
【図11】



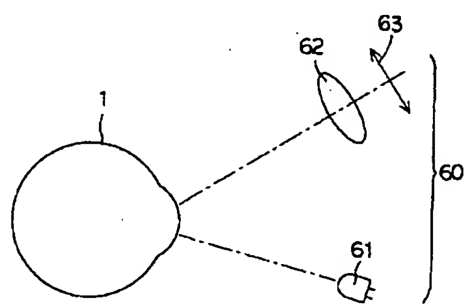
【図12】



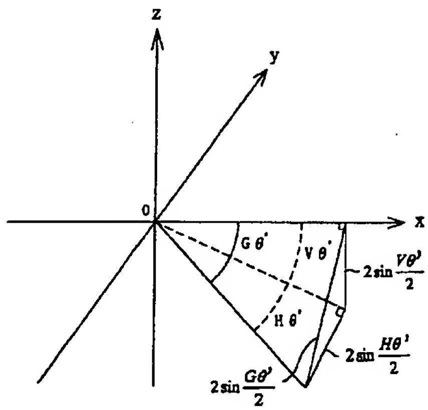
【図13】



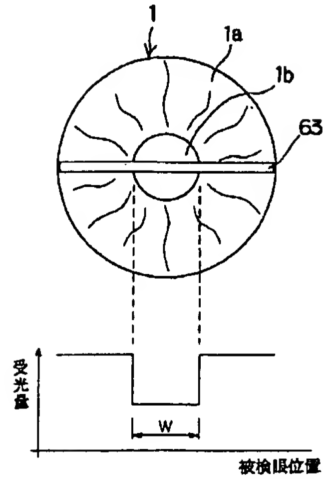
【図15】



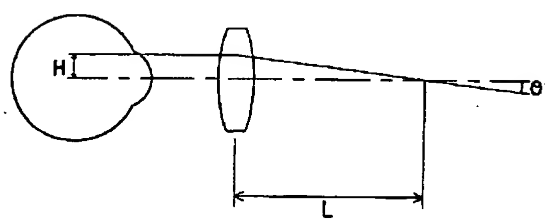
【図14】



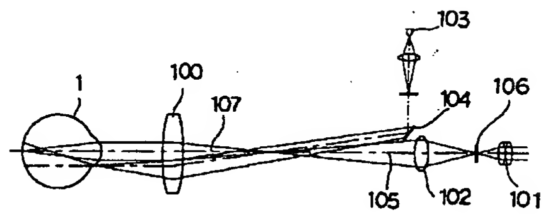
【図16】



【図17】



【図18】



フロントページの続き

(72)発明者 加藤 宏政
東京都千代田区丸の内3丁目2番3号 株
式会社ニコン内